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# AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

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NINETEENTH YEAR.

No. 8,
Feb. 20,
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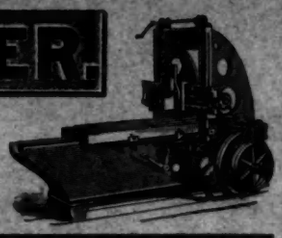

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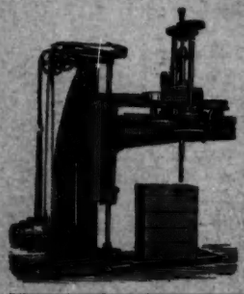

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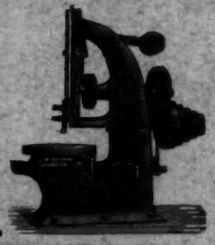

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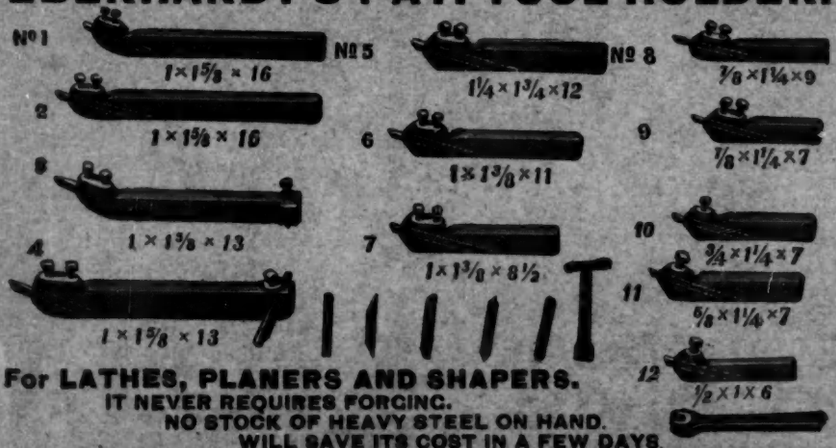


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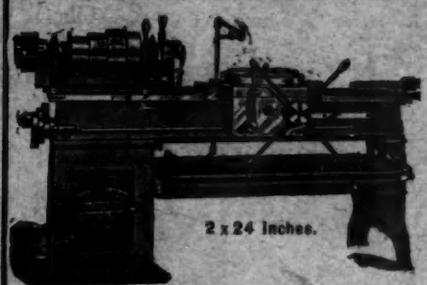

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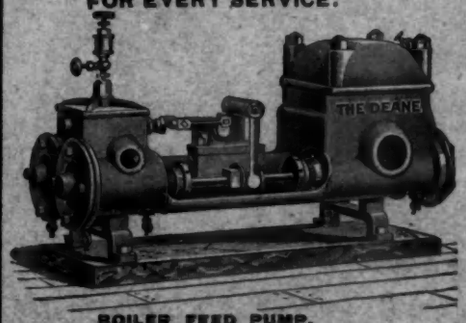


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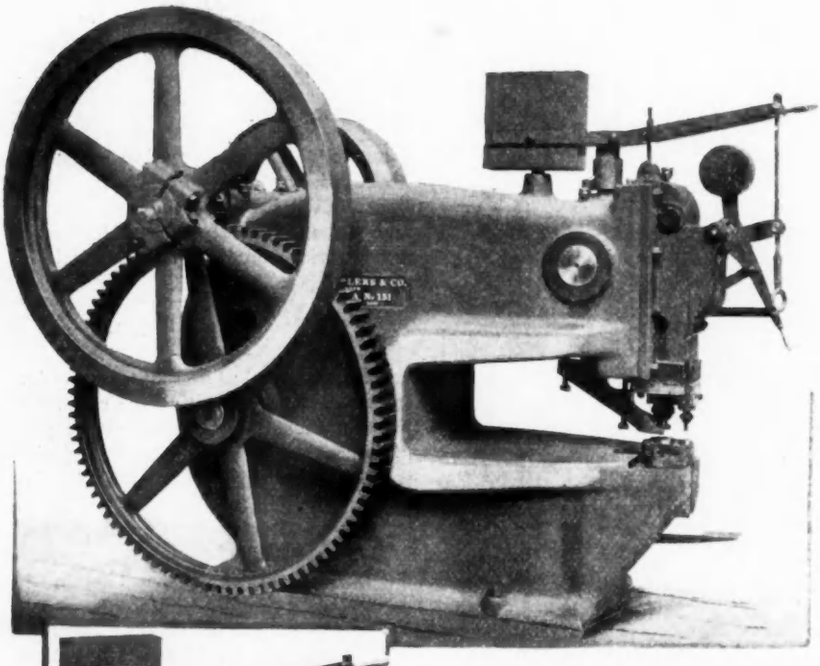
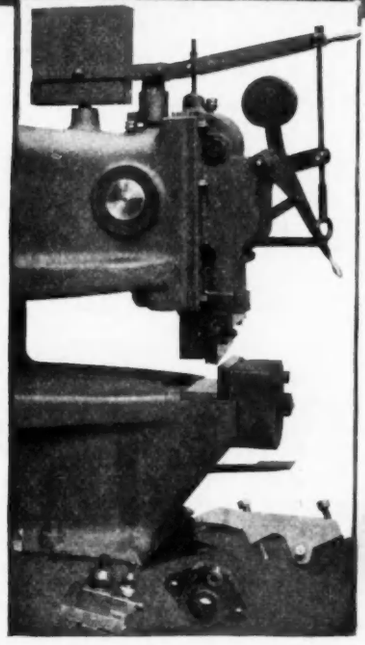




PUNCH CONVERTED TO SHEARS

## The Toggle-Joint Stop Motion for Punches and Shears.

We have received an inquiry from a correspondent as to the operation of the toggle-joint stop motion used upon Sellers' punches and shears; and by the kind permission of Messrs. William Sellers & Co. we are permitted to present some illustrations and a slight description of the device, believing that it will be of interest to many of our readers.

Clutches, gag-blocks and other devices have been employed for disconnecting the operating lever for slow-moving punches and shears without much objection; but as the operating speeds have increased, and the time permitted for throwing in has been reduced, there has been quite a danger of only a partial engagement, and frequent breakages have occurred from this cause. The toggle-joint stop motion remedies this defect and increases the facility of operation. It will be seen, when the device is understood, that the working pressure cannot come upon insufficient surfaces, as, if the toggle joint is not thrown in straight enough, it "knuckles" out, and can be thrown in upon the next stroke.

The half-tone of the full machine shows a Sellers punch with the toggle joint stop motion. The second half-tone shows the front of the same machine changed to shears, with the punch, die and stripper removed and lying in the foreground.

The operation of the toggle joint will be understood from Figs. 1, 2 and 3. The weight of the sliding head *A* is balanced by the lever and counterweight above; and when the toggle joint is not engaged, the slide may be moved up and down by hand, as may be desired for adjusting the punch, die, stripper, gage, or whatever may be necessary. The operating lever *B* is positively connected to the shaft at the back of the machine, and runs continuously. The under side of this lever, vertically over the punch, has a finished cylindrical surface, the axis of which stands transversely to the lever, and at this axis is mounted the triangular lever *D*. When the hand lever *C* is pushed into a vertical position, as shown in Fig. 3, the upper nose of the triangle D engages with the pin *G;* and when the motion of the main lever is upward, the sliding head must be raised correspondingly. At the same time, the blocks *E* and *F*, with their cylindrical surfaces in contact with each other, and the upper surface of *E* in contact with the under surface of the main lever *B*, come vertically between the punch and the lever above; and when the downward stroke is made, present large surfaces to sustain the thrust. Light straps or connections keep these blocks *E* and *F* and the lever *B* in contact; but when the hand lever *C* is drawn outward from the vertical position, as shown in Fig. 2, the centers no longer remain in the vertical line, and the upper nose of *D* also has no contact with the pin *G;* consequently, while the lever *B* may continue to play up and down, it will not move the sliding head *A*, or the punch or shear blade which it carries, and the slide may be moved up and down by the hand rod suspended from the balancing lever.

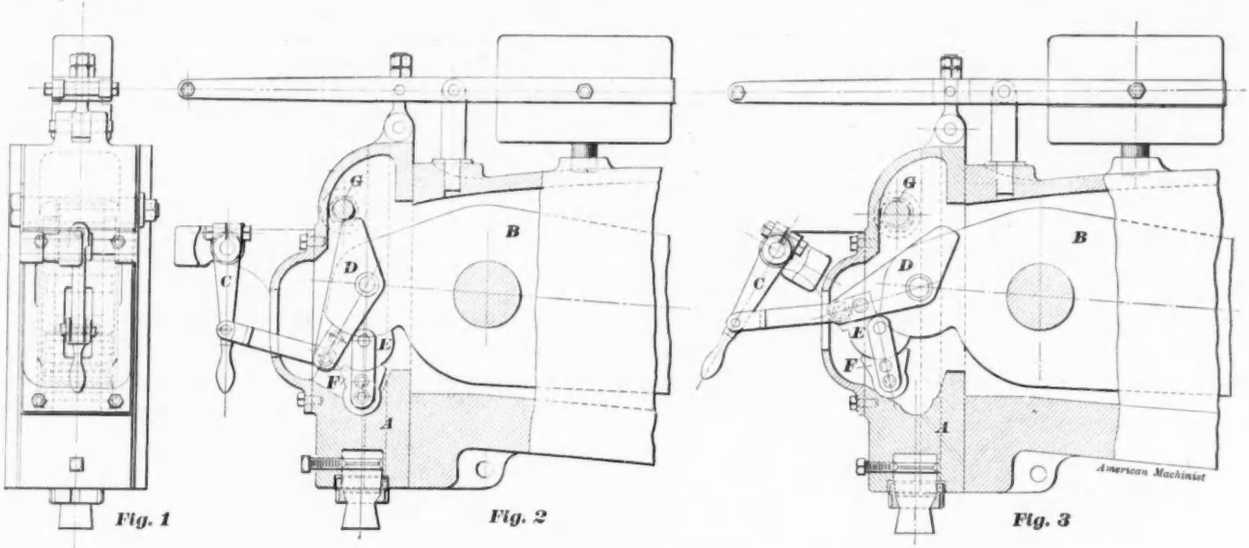



Fig. 1 Fig. 2 Fig. 3

STOP ENGAGED. STOP DISENGAGED.

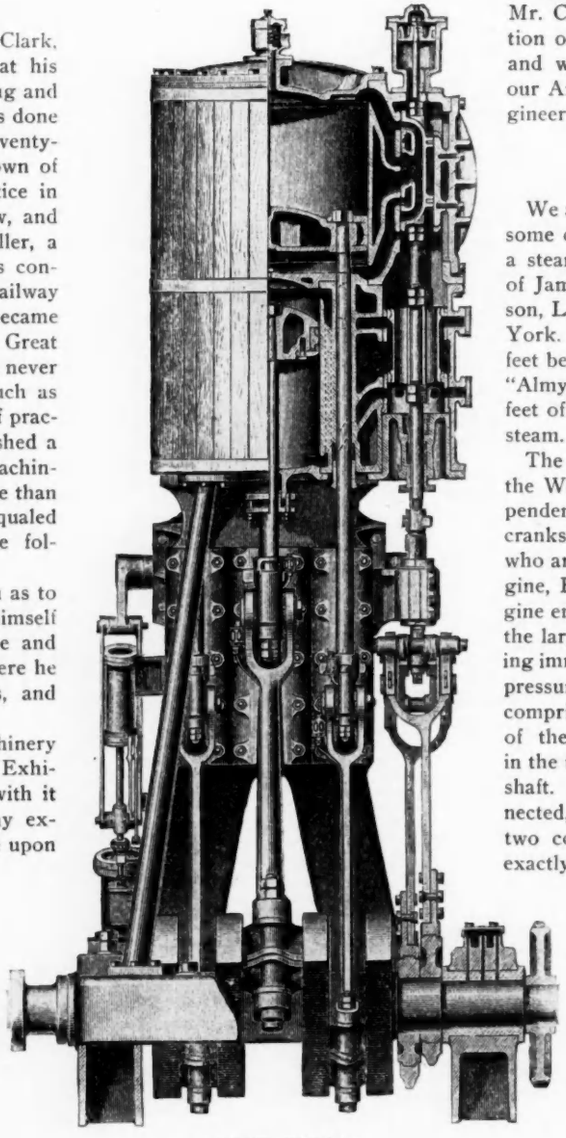
## Death of D. K. Clark.

In the death of David Kinnear Clark, which occurred on January 22d, at his residence in London, the engineering and mechanical world loses one who has done it good service. Mr. Clark was seventy-four years of age, and little is known of his early life. He was an apprentice in the Phoenix Iron Works, Glasgow, and after that an assistant of Mr. Miller, a civil engineer of Edinburgh. This connection brought him right into railway work, and after three years he became locomotive superintendent of the Great Northern of Scotland Railway. He never became a practical engineer so much as an experimenter and a formulater of practical knowledge. In 1855 he published a book on the locomotive and the machinery of railways, much more complete than any which had preceded it and unequaled by any of the many which have followed it.

The success of the book was such as to warrant Mr. Clark in establishing himself in business in London. His office and his residence were together, and there he lived and worked for forty years, and there he has just died.

Mr. Clark had charge of the machinery department in the International Exhibition of 1862, and in connection with it conducted a number of noteworthy experiments, among them being those upon centrifugal pumps.

Mr. Clark's great work, entitling his name to the lasting respect of the mechanical profession, was the publication, in 1877, of his "Manual of Rules, Tables, and Data for Mechanical Engineers." There is no other work like it, at once so comprehensive, so reliable and with contents so readily available. Mr. Clark published other works, but none to compare with this in practical usefulness. Mr. Clark was a Member of the Institution of Civil Engineers of Great Britain, and was also an Honorary Member of our American Society of Mechanical Engineers.

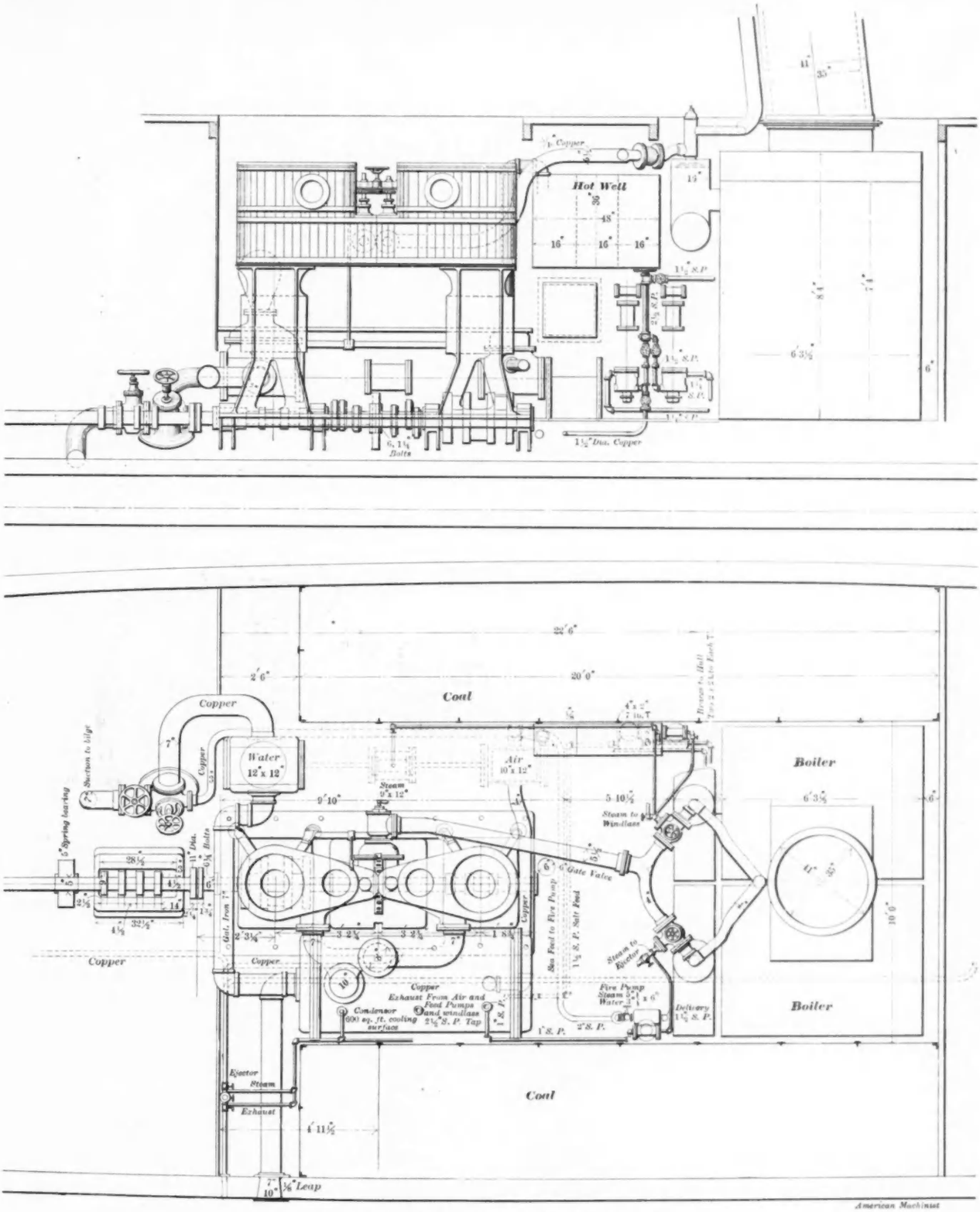


YACHT ENGINE.

## A New Yacht Engine.

We are enabled to present to our readers some drawings illustrating the engines of a steam yacht now building at the yard of James M. Bayles & Son, Port Jefferson, L. I., for Mr. E. S. Renwick, of New York. The hull is to be 130 feet long, 20 feet beam and 11 feet depth of hold. Two "Almy" water-tube boilers, with 20 square feet of grate surface each, will supply the steam.

The engines are of the type known as the Wells balanced compound, two independent engines being employed upon cranks placed 90 degrees apart. To those who are not familiar with this type of engine, Fig. 1 will make it clear. Each engine employs two double-acting cylinders, the larger or low-pressure cylinder standing immediately above the smaller or high-pressure; the two cylinders, in fact, being comprised in a single casting. The piston of the high-pressure cylinder connects in the usual way to a crank upon the main shaft. The low-pressure piston is connected, by means of two piston rods and two connecting rods, with two cranks exactly opposite to and at each side of the first crank. The parts of the high-pressure system and of the low-pressure system being made of equal weight, the engine is, of course, balanced in any position, and may be run without jar at any speed. The two engines employed in the present case being of this type, and the cranks of each being at right angles to the other, there are no dead centers,

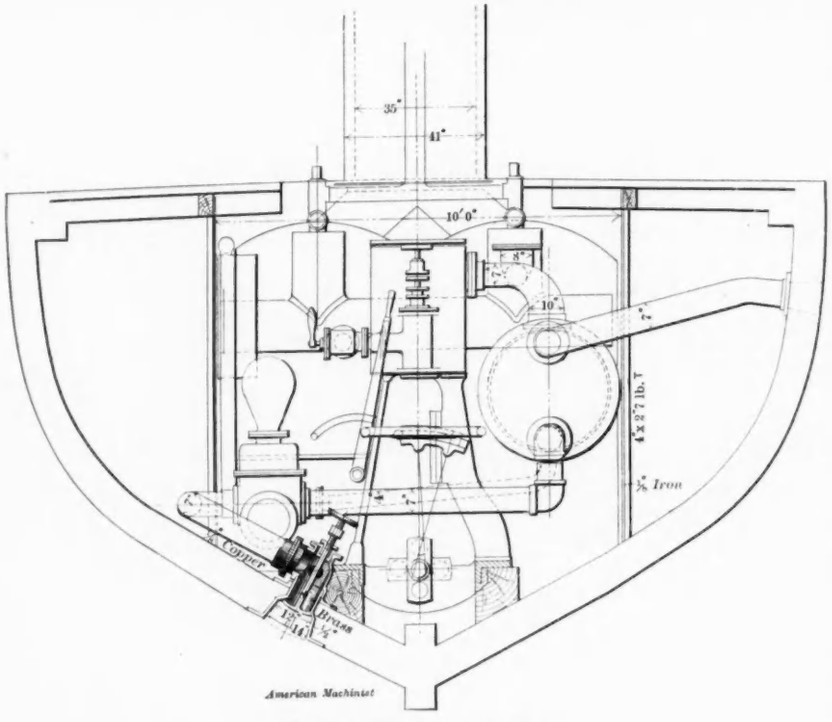



ARRANGEMENT OF MACHINERY IN YACHT.

no unbalanced positions, and the steam distribution gives a very uniform and constant effort upon the shaft.

The engines are fitted with piston valves throughout, and have independent admission and cut-off valves. With an initial pressure of 100 pounds, the engines will develop 450 horse-power, and they may be instantly reversed when running at full speed.

A De Lamater four-bladed screw will be used, 6 feet diameter, 8 feet pitch; a Lighthall surface condenser, with independent combined air and circulating pumps, two independent vertical boiler feed pumps, and an independent fire pump. Many engineers and others would be glad to know of the practical performance of these engines, but, unfortunately, a pleasure yacht does not offer much opportunity for reliable determinations.




CROSS-SECTION OF YACHT.

when thrown to either position is locked in that position until the rope is pulled again. There is no rigid shipper in the way; there is never any hesitation as to which way to throw the shipper, in case it is desirable to stop suddenly; there is no limit as to the height at which the device may be used, and by the aid of leading pulleys the rope may be brought down wherever may be most convenient.

Figs. 3 and 4 show the construction and operation of the shipper. The rope shive *a* turns easily on the fixed stud *e*. The clock spring *b* is fastened to the hub of the rope wheel, and also to the overhanging flange of the hanger at *d*, and serves to return the rope wheel to its normal position after each pull of the rope. The tension of the spring is sufficient to overcome the weight on the rope and to bring the wheel back. The normal position of the rope wheel is shown in Fig. 3, where the lug *c* of the wheel is in contact with the lug *i* upon the inclosing case. When the rope is pulled, the wheel can turn until the lug *c* strikes the lug *o*, thus making one-half revolution, or a trifle more. The wheel carries a pawl which engages in one of the two opposite

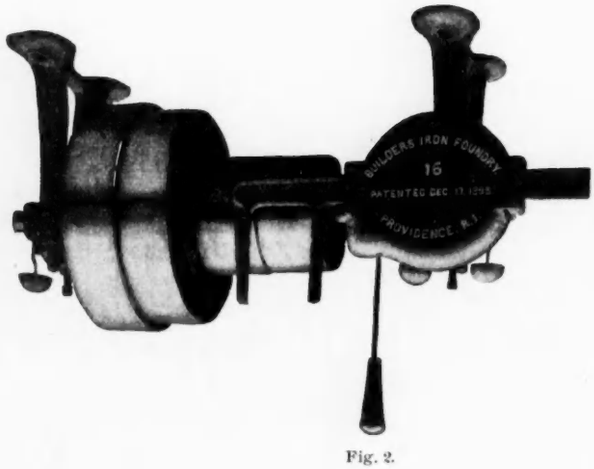



Fig. 2.

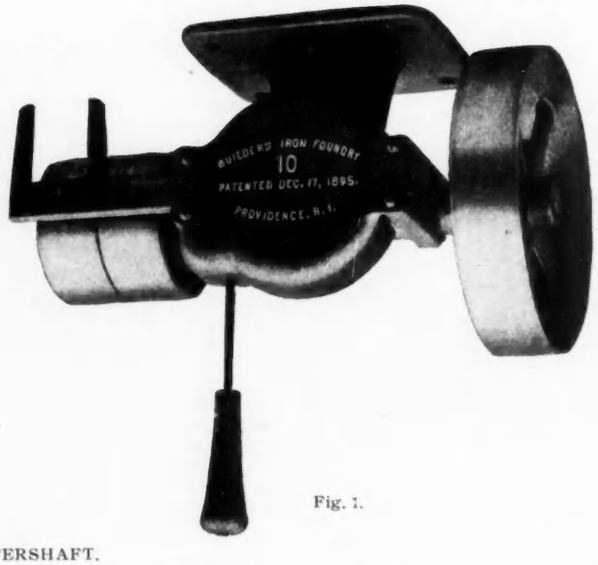


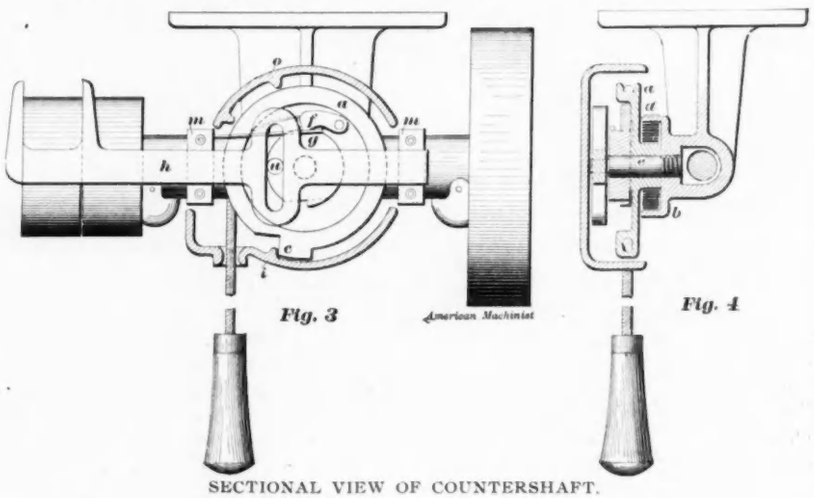

Fig. 1.

A NOVEL COUNTERSHAFT.

## A Novel Countershaft.

We take pleasure in calling the attention of our readers to a new countershaft combining novel and valuable practical features, and several points of interest to mechanics and designers in general. Fig. 1 shows a countershaft complete with a single hanger, and Fig. 2 shows a longer shaft with two hangers and all the pulleys within them. The shafts shown are used for driving emery wheels, but they may, of course, be as readily used for any other service.

The special feature of the arrangement is in the shipper. This is operated entirely by pulling the rope with the weight or handle attached. A pull throws the belt on, and a pull throws the belt off, and so on continuously. The shipper,




SECTIONAL VIEW OF COUNTERSHAFT.

notches on the periphery of the wheel *g*; consequently, each pull of the rope, moving the wheel *a* from the stop *i* to the stop *o*, imparts to the wheel *g* one-half revolution for each pull of the rope, and always in the same direction. This wheel *g* carries a pin *u*, which works in a vertical slot in the shipper *h*, and at each half revolution moves the shipper from one extremity of its travel to the other. It will be noticed that the caps *m m* may be easily removed, when the shipper may be inverted for a belt running the other way.

The countershaft is made in several different sizes by the Builders Iron Foundry, Providence, R. I.

## Bicycle Tools—XVII.

TOLEDO MACHINE TOOL SHOPS.

Toledo, O., is a finely-built town of something over a hundred thousand inhabitants, with wide streets, four or five theatres, a multitude of churches, and a great abundance of trolley lines equipped

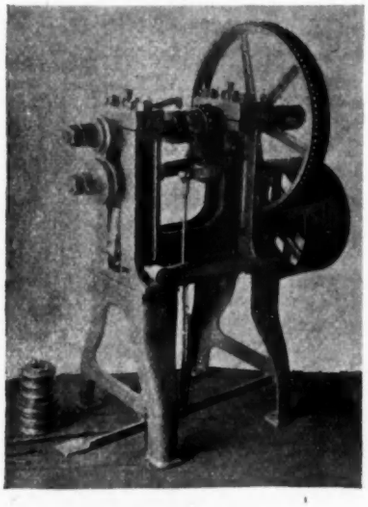


Fig. 107. RIM ROLLS.

with fine vestibule cars, which transfer passengers from one to the other in the most amazing and bewildering manner, so that, were not the conductors unusually painstaking and solicitous, a passenger strange to the systems might easily ride all day for a solitary nickel and never know where he was at in the whole time.

Toledo is said to have the second-largest wagon factory in the world, yielding precedence to Studebacker only, and has a very large tin can factory, and many other well-managed and flourishing manufactories; and, in addition to these, had on the first day of February, 1896, thirteen cycle factories—the number may be more before this is printed, but it was thirteen on the day mentioned. These factories are as follows: Colton, Dauntless, Gendron, Kirk & Young, Lozier, Maumee Mfg. Co., Snell Co., Truman Cycle Co., Toledo Metal Wheel Co., Tally-ho Tandem Co., Union Mfg. Co., The Wilson and The Yost. These thirteen companies, directly engaged in the manufacture of cycles complete or cycle parts, are down in cycle production estimates for an aggregate production of 135,000 wheels in the season of 1896. The Gendron, Yost and Lozier are large establishments, and the Lozier is particu-

Fig. 108. TIRE STRETCHER.

larly interesting from a mechanical standpoint, as having set for itself a strictly ideal mark for the quality of its production.

In the Toledo cycle factories examined, a number of machine tools by unfamiliar names were noted, all good of their class, and some of them excellent. These tools were all of Toledo make, and led to an examination of the shops in which they were made, viz.: The Geo. W. Heartley Shops, presses and metal wheel tools; The Toledo Machine & Tool Co., presses, square shears, automatic link-belting making machines and special tools; and Baker Brothers, who make a line of woodworking tools, a line of extremely

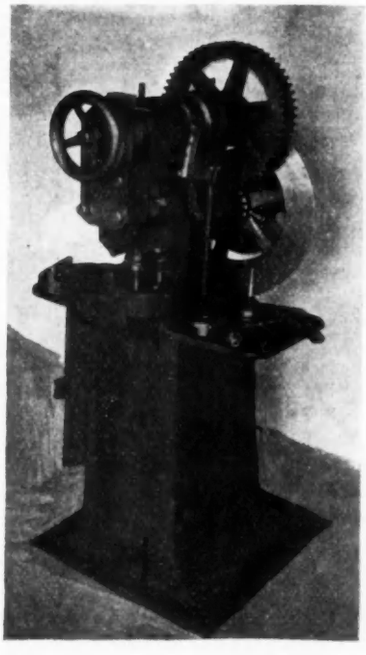


Fig. 109. SMALL GEARED PRESS.

efficient key-seaters, and a heavy cycle drilling machine. This Baker driller is adapted to piecing up, by interposed stretchers between the upright drill frames, which are of the box goose-neck

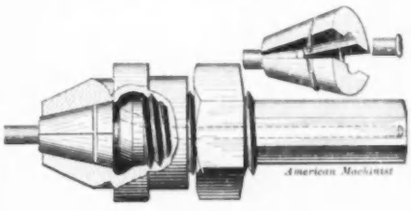


*Fig. 110*

PUNCH CHUCK.

type, into banks of any desired number of spindles, and hence are named "Multi-Spindle" drillers; although, as at present constructed, they have an individual overhead countershaft for each spindle, and are therefore really independent drillers, framed in bank instead of multiple-spindle proper, in form. A modification of this extremely efficient and popular tool

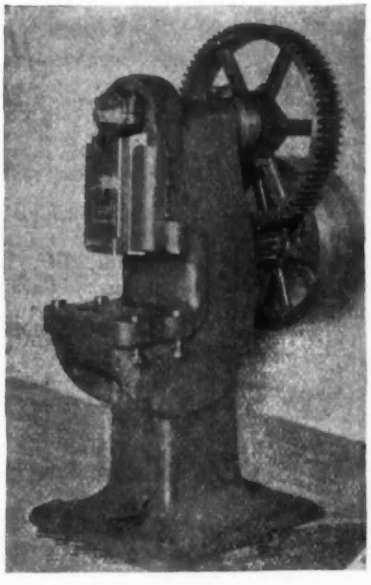


Fig. 111.

was shown on the drawing-board by Mr. Colburn, in which a single long counter, at the base of the bank of drillers, drives the whole lot, and so brings these admirable tools in closer line with the latest practice, by adapting each bank to driving by an independent electric motor.

The Heartley Shops were started by Mr. Geo. W. Heartley, blacksmith and machinist, in Toledo in 1881, and in 1885 Heartley began on his present line of metal wheel and band tools and power presses.

So far, these papers on cycle tools have not dealt with the plants which make what are called "Youths'" wheels, the cheaper grades of cycles, although a vast output of such wheels is sold yearly. For the metal wheels of such low-priced cycles, Mr. Heartley makes a full plant,

consisting of spoke benders, hub closers, and rim welders and risers. The Heartley tools are all distinguished by simplicity and, as may be expected from Mr. Heartley's personal familiarity with the

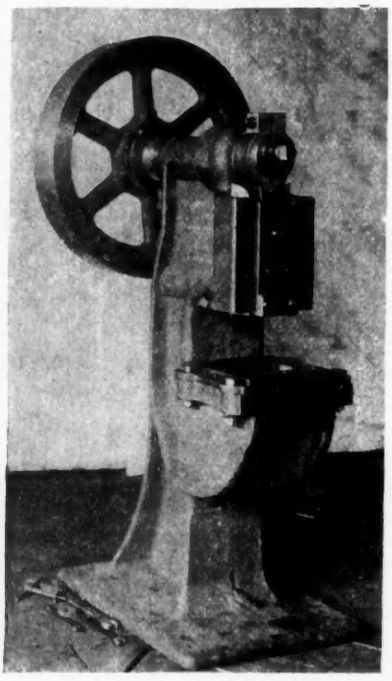


Fig. 112.

art of blacksmithing, a perfect adaptability to hot metal operations.

The rim-welding machine, Fig. 107, consists of a pair of strongly-geared rolls; the under one toggle and treadle-

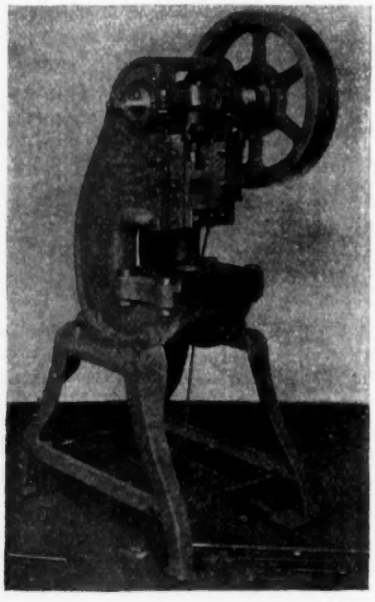


Fig. 113. INCLINED PRESS.

lifted to the upper roll, from which it is driven; the treadle is also connected to a clutch-operating bell crank. The clutch employed by Heartley is not of the usual "Johnson" or "Stiles" pattern; it is simply a one-tooth plain spiral clutch, and is very simple and very durable. The top roll is continuously driven; the bottom roll drops down and stands still when the treadle is released. In operation, the rim blank is cut exactly to finished circumference length, bent in a suitable bender to such a diameter as will give a sufficient weld-lap, brought to a welding heat and hung on the stationary lower grooved roll; pressure on the treadle lifts the lower roll to finished rim section of roll opening, and at the same time clutches the top roll pinion to the top roll shaft, which causes the lower roll to revolve, and the lap of the tire is at one revolution drawn down to the section of the original tire stock, and is, of course, made a very close approximation to the desired diameter.

To make the diameters exactly uniform, the tires are handled from the welding machine directly to the rim-sizing machine, Fig. 108, and placed on the table outside of the changeable, collapsing sizing ring; by a pull on the lever, a double-toggle action is had to expand the sizing ring, and so slightly stretch the still hot wheel rim as to bring all tires put over the sizing machine very nearly to one diameter, this diameter being varied by changing the sizing ring in an obvious manner. A pile of these different sizing rings are shown in the engraving.

The design of the Heartley geared press, shown in Fig. 109, speaks for itself; the box column has a door and shelves, and the tool trays on each side are very convenient. The total weight of this compact and powerful little tool is 1,250 pounds, geared 3 to 1, with a 250-pound wheel, 32-inch diameter.

Heartley's complete outfit for small metal wheels includes a spoke-riveter (automatic), which rivets a 20-spoke wheel in 20 seconds and gives as good a spoke tension as can be had by hand-work; wheel-spoke benders (chevron spoke), malleable wheel-hub closing presses, wheel-spoke trimmers, and automatic tire-punching machines which will pierce $\frac{5}{16}$-inch tires with No. 12 Birmingham gage punches. All of these are extremely interesting tools, and might well claim a place in these articles did space permit. These engravings are taken from photographs furnished by Mr Heartley, rather than from the shops where I saw them in use, because of the bad light, which made good pictures impossible.

The Heartley cycle-wheel spoke header, and spoke header and bender combined, and adjustable frame-pinning jig, and sprocket and hub-capping press, will be shown in their proper connection with other tools of the same class.

The Heartley "Ideal" self-oiling adjustable punch holder, Fig. 110, enables round punches to be very cheaply made from the round rod of tool steel of proper diameter, and held securely, all sizes in one holder, "collet" drill-chuck style. Small round punches often break, and require frequent grinding on the end to do good work; and the use of this punch holder, which is self-oiling through the oil hole shown in dotted lines in Fig. 110, will, in very many cases, greatly reduce the cost of round-punch maintenance.

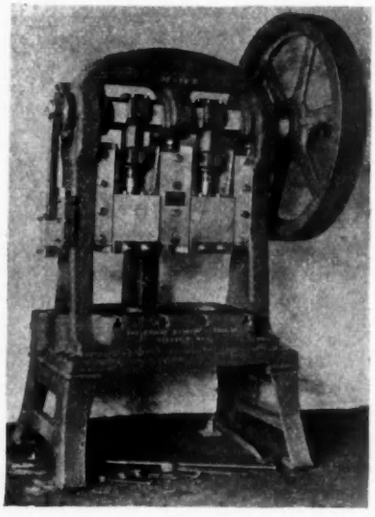


Fig. 115. TRIMMING PRESS.

The manufacture of metal wheels, as practiced at the Gendron Cycle Shops, where a vast number of toy and youths' cycles and tricycles are made, is most in-

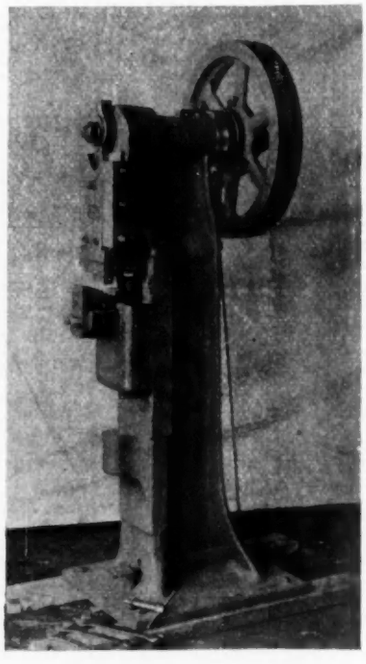


Fig. 114. RIVETING PUNCH.

teresting, both because of the extremely original and surprising tools employed, and the extremely low cost at which wonderfully strong and good metal wheels are produced; and I once more express my

regret that space will not allow me to detail this instructive art.

The Toledo Machine & Tool Co. are working even beyond their capacity, as they are contracting work outside of their own shops, and are yet unable to fill their orders for cycle tools. They are giving their principal attention to a line of well-designed presses, of which five engravings are given herewith. Fig. 111 shows their box-frame geared power press, No. 34—weight 3,500 pounds, geared 6 to 1; fly-wheel 600 pounds weight, 32-inch diameter—in use at the Lozier and other cycle shops: 45-degree angle slide gib. Fig. 112, plain press, ribbed frame, No. 32—weight 2,200 pounds; 450-pound wheel, 32-inch diameter—in use at the Snell, Lozier, Yost and other cycle shops. Fig. 113 is their inclined open back. Fig. 114 is No. 30—weight, 1,100 pounds; fly-wheel 300 pounds, 26-inch diameter; horn or riveting press—in use in various cycle factories. Fig. 115 shows a three-slide trimming press—weight 10,000 pounds; 1,500-pound wheel, 52-inch diameter—in use by Withington & Cooley and Jackson Cycle Forging Shops; the Snell Company have three of this pattern in use.

The horn press, Fig. 114, has a "Stiles" rod. The others have a globe-end lower member, threaded into a cast top member, with female thread and pinching screw, which is, perhaps, open to fewer objections than any other style of adjustable press connecting rod. Those familiar with power press design will see much in these machines to praise, and little to condemn.

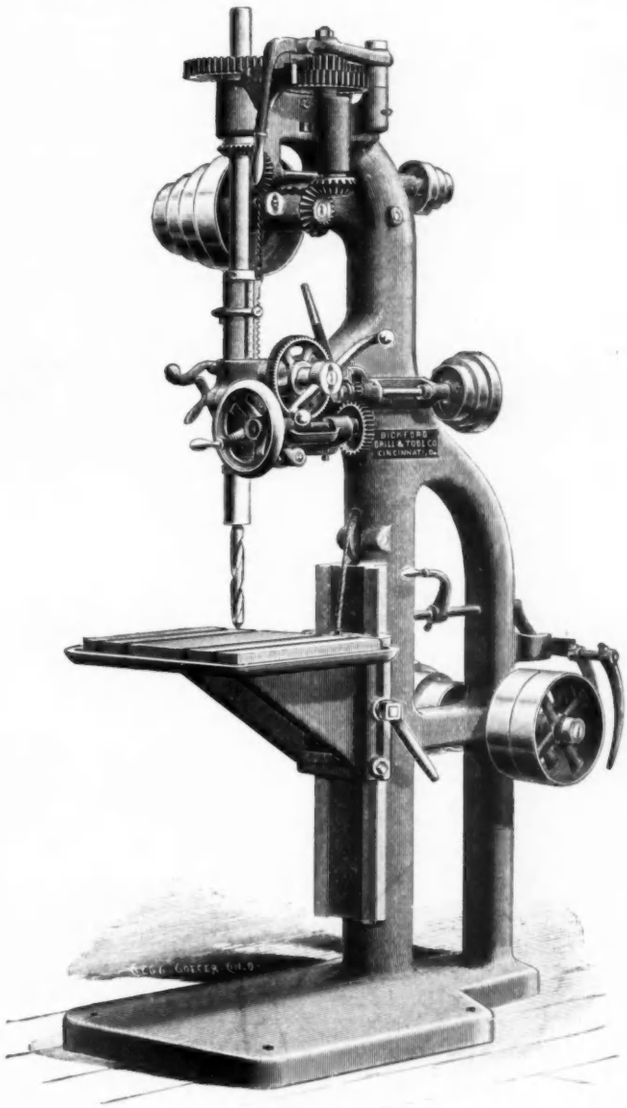
Baker Brothers make for the machine trade generally their line of powerful key-seating machines, with which the readers of the "American Machinist" have been made familiar. This machine is now under consideration in modified form, as a broaching machine specially adapted to cycle factory use. Broaching cuts are at present little used in cycle making. That the use of the broach might be greatly extended in the production of profiles is an opinion long entertained by some of the most experienced small-tool makers in the country, and perhaps the present eager search for improved methods of cycle detail manufacture may result in bringing broaching cuts into a prominence hitherto unknown.

The bank driller made by the same concern, and illustrated in these columns January 10th, 1895, is one of the most powerful and rapid drilling machines in use. Regular day in and day out performances of these drillers are as follows: hole 1 15-16-inch diameter, 3⅜ inches long, drilled in 6 minutes 20 seconds. Hole 1½-inch diameter, 3¼ inches long, drilled in 3 minutes. At the Lozier these machines were being very lightly worked when I saw them, drilling holes 1¼-inch diameter, 2¾ inches long, in 4 minutes. The lubrication, soapsuds and best lard oil mixed, flooded.

I have taken pains to procure full particulars of this extraordinary performance, which is far beyond the production of some drilling machines ranked as extremely good. Superintendents having heavy cycle drilling in charge can make their own deductions from these statements. One inch feed per minute for an inch and a half drill in drop-forging stock is enough to excite attention. The thrust of this rapid drilling is taken by a ring of thirty-one hard balls, ¼-inch diameter. In the first spindles put up these balls were seated in case-hardened machine-steel rings, with plain grooves, nearly semi-circular, the grooves being slightly widened at the face of the ring so as to insure a fair bearing on the bottom. These soft-core case-hardened rings failed. Had they been hardened through, as they might have been by proper packing and firing, they would have failed, if at all, by breaking across the section, which was too small; as they were, they rolled the metal of the ring down in a wedge under the tread of the balls, and forced the wall of the groove outward at the top. In the improved design these ball rings will be of tool steel, hardened, of increased section, and the balls will be twenty-six in number and 5-16-inch in diameter.

### The Latest Upright Drill.

We illustrate the latest upright drill. It has been developed under the demands of the bicycle manufacturers, and embraces several novel and good features. The most striking departure to be noticed is in the arrangement of the driving shaft, which is placed at right angles to the position usually adopted. Any number of these drills may be placed side by side, and each may be driven directly by a single belt from the same shaft. The drill illustrated is the 24-inch pattern, and drills of this size may be set 30 inches apart and still give the operator ample room for changing cone belts or any other operation necessary. Jigs may also thus




A NEW DRILL PRESS.

be easily transferred from one table to another.

The back gearing also of the drill is arranged and operated in a novel way. By a conveniently located handle the gears may be instantly thrown in while the spindle is running, or the spindle may be stopped at once by the same handle without waiting to ship the belt

The feed is either hand or power, with quick return and an automatic stop readily adjustable, as required. The drill may be instantly engaged; and after the stop has operated, the drill may be returned without loss of time, such as unscrewing friction disks or other arrangements. It is only necessary to turn back the double-ended ball handle, which is secured to the pinion or worm-wheel shaft. The worm revolves continuously on a swiveling shaft, and the automatic stopping is done by throwing the worm out, while the re-engagement is only the throwing of the worm in again. The spindle is counterbalanced and works on ball bearings.

The table, which also is counterbalanced, is rectangular, T-slotted, and has an oil channel with a ½-inch pipe-tapped hole for draining. The table is clamped by one bolt, which presses the V-shaped gib firmly to the drill column, securing accurate alignment. The planed surface of the table is 18 x 20 inches, and its vertical adjustment is 16 inches. The back-gears are 1 to 8½; the spindle is 1 9-16 inches at the quill, it has a feed of 10 inches and is bored to fit No. 4 Morse taper. The cone pulleys are 10½, 9, 7½ and 6 inches for 2½-inch belt; while the tight and loose pulleys are 10 inches for 3-inch belt. Weight of machine, 1,150 pounds. The drill is built by the Bickford Drill & Tool Co., Cincinnati, O.

## On the Care of Plumbago Crucibles.

The Joseph Dixon Crucible Company give directions for the satisfactory management of plumbago crucibles, from which we take the following:

"1st. On the fit of the tongs. In a fire hot enough to melt brass, or copper, the crucible becomes soft and pliable. In lifting it out to pour, if the tongs do not fit, or are not made to grip the crucible at the right place, it is easily squeezed out of shape and is liable to crack. The Dixon Company suggest that the tongs be made to grip the crucible just below the bilge, so that it will not need such a tight squeeze. Some melters use tongs shaped like the ace of spades; such tongs remove the coal much more easily than those of the regulation shape.

"2d. On the kind of coal used for fuel. Coal with too much sulphur destroys, unnecessarily, the life of the melting-pot. I have seen a carload of crucibles give 25 per cent. more heats by a change of coal.

"3d. The melter must not expect as many heats in melting one metal as another. From three heats when melting nickel, to six in melting steel, to twenty-four in melting copper, the heats run up in the forties when melting composition.

"4th. The drafts and dampers, if arranged to produce a reducing atmosphere, as against an oxidizing atmosphere, will lengthen the life of the melting-pot. An oxidizing flame is always unfriendly to a plumbago crucible.

"5th. The flux used also bears on the same result. The binding materials in the walls of the crucible are impervious to some fluxes and easy victims to others.

"6th. The time of heat is also to be allowed for. If with modern furnaces,

DRILL PRESS FOR BICYCLE FRAMES.

high drafts, and taller stacks, the heat is taken off in 1½ to 1¾ hours, don't expect your crucible to stand this large punishment as easy as the lighter strain of a 2½ to a 4 hours' heat.

"7th. If, in ordering your crucibles, you could give a hint to the maker as to what metal is to be melted, he could tell better what crucibles to send.

"In the old days a crucible was a crucible; in these modern days we make by twenty different formulas, or 'mixtures,' as they are called. So tell your maker what you propose to melt, and you will get a crucible better adapted to the work and one that will last longer.

"8th. After pouring your metal, don't roll the pot out of doors where it will get rained upon, or on a bed of wet sand, or where it will absorb moisture. If you do, you will put it exactly where in its hot, soft condition it will become spoiled either teetotally or partially. Also, in lifting large pots by the crane, don't release the grip and let them drop four or five feet on stone floor; rather hold the grip until within two or three inches from the ground, and then drop them if possible on a bed of old dry sand.

"9th. Don't leave any metal to cool in the crucible, but pour until the melting-pot is clean empty. In the parlance of the shop, don't leave the crucible so you will find a 'button' in the bottom when it is cooled off.

"In cooling, each button will have small threads or spikes of metal which will attach themselves to the soft crucible walls and get solidly stuck in them, and they tear the walls of the pot to get them out.

"10th. In charging the crucible, don't wedge the scrap in too tightly; expansion and contraction go on in the heating and cooling, and a careful charging will provide for this."

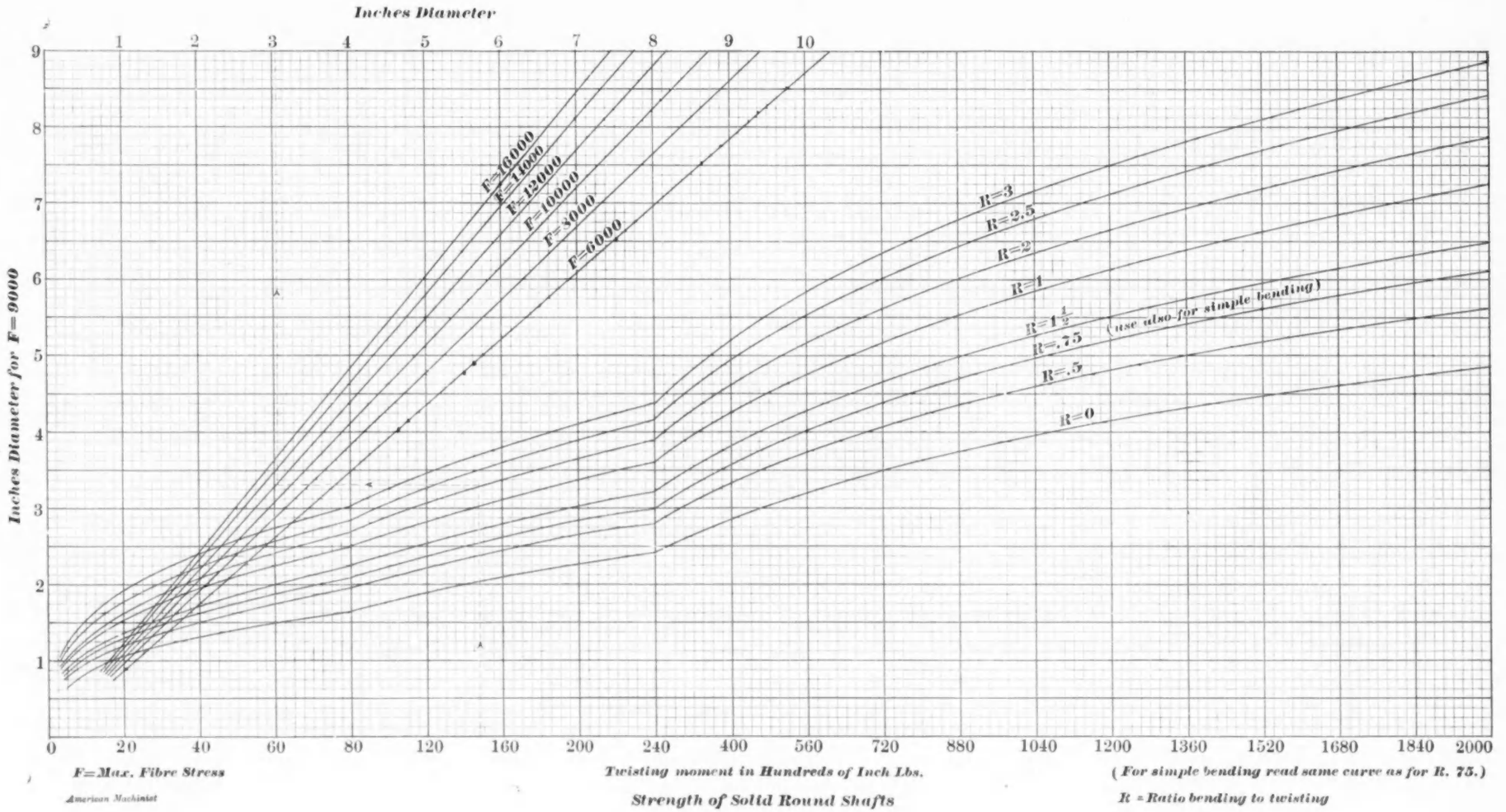
## Drill Press For Bicycle Frames.

We have illustrated in previous issues a friction-driven drill press made by the Stover Novelty Works, of Freeport, Ill. It will be remembered that this machine is so arranged that the turning moment derived from the friction wheels is proportioned to the requirements, varying with changes of speed made to suit different sizes of drills; and that when the end pressure is removed from the spindle, the wheels are automatically disengaged.

Our present illustration is of this drill press specially adapted to drilling holes in any part of a bicycle frame, the distance between spindle and column being abnormally increased to give room for the work. It drills holes from the smallest to ⅜ inch; and yet, by the rule, usually adopted for size of such machines, would be called a 22-inch drill press.

The technical schools of England have so increased the supply of budding electrical engineers as to lead to a great surplus of supply over demand. Advertisements for borough electrical engineers call out an average of one hundred replies each. The result has been a great fall in salaries, which, for borough engineers carrying considerable responsibiltiy, scarcely exceed those paid to workmen in the shops. The application of electricity to power purposes is much more restricted there than here, and relief from present conditions is looked for in the growth of these and other applications.

Once more the lesson regarding the foolishness of putting big wrenches on small valves, to tighten them up, has been taught—this time by a fatal accident. The explosion of acetylene gas at New Haven, to which we referred in our issue of January 30th, was caused, it seems, by the rupture of a valve, the rupture being caused by the application of a 30-inch wrench to the valve to tighten it up. The wrench was used by a machinist—one of the three men killed by the explosion.




## Strength of Shafts.

BY CHAS. L. GRIFFIN.

The accompanying diagram for the strength of solid round shafts is designed to assist in determining the diameters of shafts subjected to simple bending, twisting, or the two combined. It is plotted from the well-known formulas for bending and torsional strength, and is arranged to read such fiber stresses and ratios of bending to twisting as are most commonly met with in practice. The writer has used the diagram for several years on a widely varying line of power calculations, and has found it a great time-saver.

Each square on the diameter scale represents one-eighth of an inch, which makes it very easy to read shaft diameters to sixteenths. Finer reading is seldom required. The diagram reads, for fiber stress of 9,000, diameter in inches at the left-hand margin. For other stresses commonly met with, read to the diagonal lines and vertically to the upper margin. An example is noted on the diagram by a dotted line, which marks the proper course. The twisting moment is 15,250 inch-pounds, bending moment 30,500 inch-pounds, giving $R = 2$. Starting at the lower margin, rise to the curve $R = 2$; thence to the left, to the diagonal which bears the given fiber stress, in this case 12,000; thence to the upper margin, where we read 3 1-32 as the diameter of the shaft. If the fiber stress had been given as 9,000, we should have gone through to

the left margin, finding the diameter about 3 5-16.

For simple twisting, read the lower curve, marked $R = 0$.

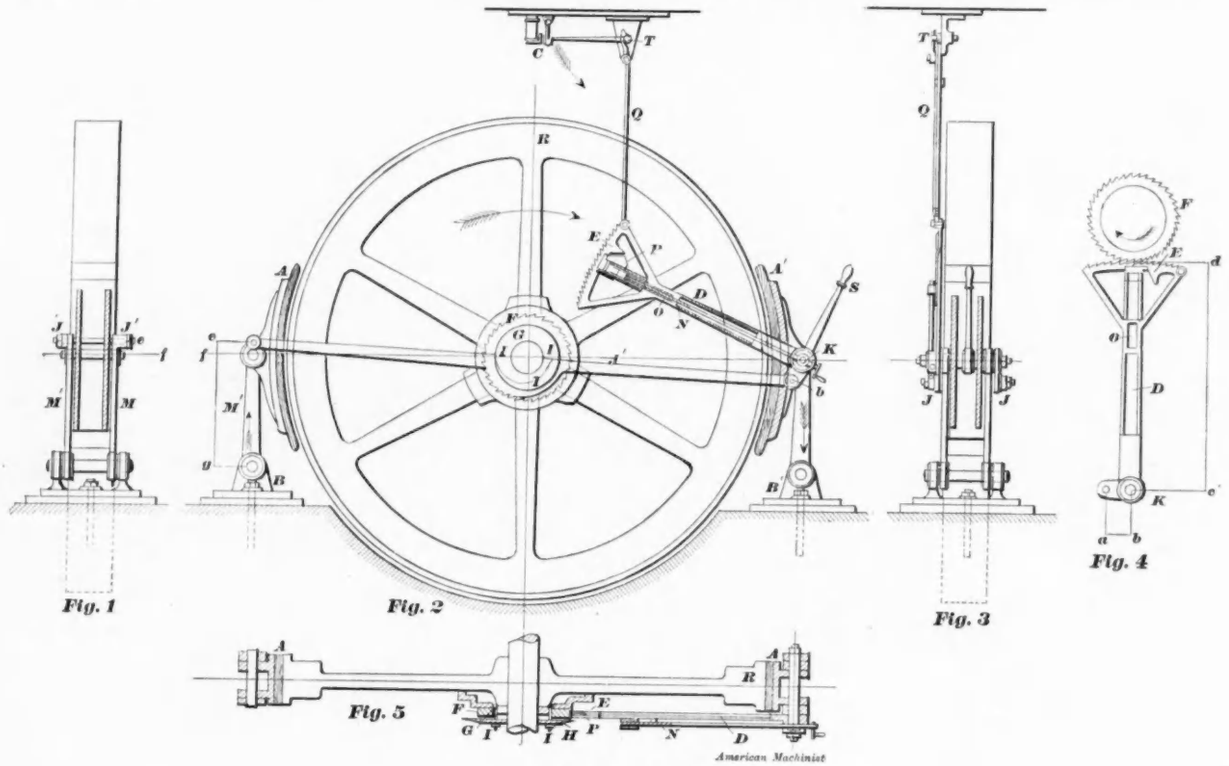
For simple bending, read same curve as for $R = .75$. It is merely a coincidence that the two curves are the same, and is easy of proof.

Springfield, Mass.

## A "Touch-the-Button" Fly-Wheel Brake.

An electrically-released brake, for quickly stopping a fly-wheel, has recently been placed upon the market in Darmstadt, Germany, and is described in "L'Industrie," Brussels.

The toothed wheel $F$ turns freely upon the sleeve $G$, except as it is restrained by the friction of the cap $H$; and thus, through the tension of the bolts $I\ I\ I$, the force acting through the levers is adjusted. The force acting upon the lever is multiplied by the ratio of the arms $c\ d$ to $a\ b$, and by means of the connecting rods $J\ J^1$ the pressure is equal upon the two brake shoes; for the pressure which acts against the fly-wheel at $K$ is balanced by the pressure of the other brake shoe, which is equal to that of the first, for the following reason: The levers $M$ and $M^1$ are prolonged above $f$, where the connecting rods $J\ J^1$ are attached, to such a distance that the part $e\ f$ above is to the part $f\ g$ below in the same ratio as $a\ b$ to $c\ d$. The balance of the brake-shoe pressures prevents all strain upon the fly-wheel shaft.




A FLY-WHEEL BRAKE.

The arrangement will be understood from the accompanying illustrations. The electro-magnet of the disengaging device is connected with any number of signal buttons placed in various parts of the shop. The magnet releases the lever $D$, which falls, and the brake immediately takes hold, stopping the fly-wheel in from one-half to two revolutions. Nothing is said about the throttle valve, although that might be closed at the same time and by a connection with the same mechanism.

When, by the operation of the electrical release, the lever $D$ is allowed to fall, the toothed sector $E$ at its extremity is caught by the toothed wheel $F$ and carried downward, the fly-wheel turning in the direction of the arrows, the brake shoes $A$ and $A^1$ being thus made to press upon the circumference of the wheel and arrest its motion.

To release the toothed sector $E$ from the wheel $F$, the wedge $P$, whose surface receives the pressure of the sector $E$, is drawn back by the screw $N$ until the nut on the screw reaches the end of the slot $O$ in the sector. The hand lever $S$ serves to throw the lever $D$ back to its original position, and the releasing apparatus arrests the hook of the rod $Q$ on the pivot $T$, the screw $N$ being then moved forward to its first position.

The brakes of the above description which have been tried have operated with certainty and without injury to the engine. They should be capable of preventing many accidents.

They are made by the Actien-Maschinenban-Austalt vorm. Venuleth and Ellenberger, Darmstadt.

## Regulations Relating to Marine Boilers —Responsibility for Ignoring Them.

Assistant Secretary of the Treasury Hamlin has recently rendered a decision which will be of interest to boiler makers:

On January 27th, the Knoxville & Chattanooga Packet Co. addressed a letter to the department, asking its authority to use two boilers, on the ground, as they claimed, that illegal construction complained of was neither their fault nor that of the makers—the boilers having been built, as they claim, under the printed rules of the Board of Supervising Inspectors; and that, in relation to one of the defects in said boilers—namely, insufficient space between the internal flues—no reference was found in said rules; and they asked to have the privilege to use such boilers, temporarily at least.

In reply thereto, Mr. Hamlin said:

"You are informed that this department has no authority to grant the privilege you ask for; for though it is true that the rules and regulations, with which you admit the boiler-maker was furnished previous to the construction of the boiler, do not contain the information in regard to space between the flues of internally-fired boilers, such failure was because of the fact that such requirement is a statutory one that boiler-makers have no excuse for being unfamiliar with, the rules and regulations only containing explanatory details of construction required by statute law, where such explanation is

necessary. In the case under consideration, the statute is explicit and needs no explanation, said statute reading as follows:

" 'Sec. 4434.—No externally-fired boiler having its shell constructed of iron or steel plates exceeding an average thickness of thirty-one hundredths of an inch shall be employed on any steam vessel navigating the Red River of the North * * *; and no externally-fired boiler employed on any such steam vessel shall have less than three inches space between its shell and any of its external flues, and not less than three inches space between such flues when any such flues are more than five inches in diameter * * *.'

"You are further informed that the rules and regulations to guard against possible ignorance of the law on the part of the boiler maker, provide:

" 'The manufacturer of any boiler to be used for marine purposes, shall furnish the inspector of the district where such boiler or boilers are to be constructed, a blueprint or tracing descriptive of same for their approval, which shall be kept on file in his office; also the kind of material and size of rivets to be used in the construction of such boilers and the size and pitch of the rivet holes in same, as well as an affidavit subscribed to, either by himself or authorized agent having superintendence of the construction of such boilers.' This for the purpose of allowing the inspector, by examination, before the construction of the boiler, to point out and instruct the boiler-maker as to defects of construction, so that the boiler-maker can remedy them before cutting up his material.

"It is assumed that no blueprint was furnished in this case, as required, and therefore the present trouble, for which, if the assumption is correct, the boiler-maker is wholly responsible, as he is in respect to the inefficient thickness of the heads of the boiler, the rule for which is contained in the general rules and regulations, which is admitted he had before him, the specific rule reading as follows:

" 'All heads employed in the construction of cylindrical boilers for steamers navigating the Red River of the North * * *, shall have a thickness of material as follows: For boilers having a diameter exceeding 32 inches and not exceeding 36 inches, not less than one-half an inch; for boilers exceeding 36 inches in diameter and not exceeding 40 inches in diameter, not less than nine-sixteenths of an inch; for boilers exceeding 40 inches in diameter, not less than one-sixteenth of an inch additional thickness for every 8 inches additional diameter required for boilers 40 inches in diameter.' "

The privilege asked for was therefore denied.

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If you have not yet expressed your choice of a school to have the Davis & Egan silver and gold-plated lathe, you should do so before March 1st.

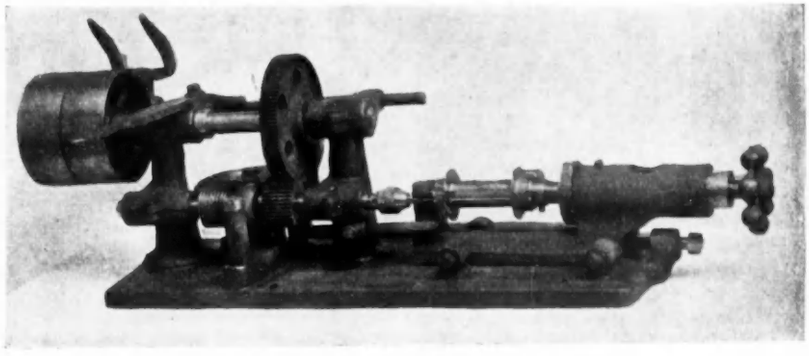
## Automatic Hub-Drilling Machine.

We present herewith an illustration of a machine designed to automatically drill the spoke holes in a bicycle hub.

The spindle is driven by gearing in the manner indicated, and a worm on the spindle drives a worm wheel, to which are attached two cams. One of these cams, by means of a lever connection, feeds the spindle forward and returns it quickly; while the other cam, by means of a second lever connection, operates the ratchet wheel at the right of the hub shown, and thus indexes the hub for the next hole, the machine being entirely automatic, except that it is necessary to place the hub in position properly and reverse it after the first flange is drilled.

An index pin enters one of the holes in the flange first drilled, and insures that those in the other flange shall be properly located.

That portion of the machine which holds the hub can be adjusted to any required position, so that the holes will be properly drilled with reference to spoke direction. The machine is intended to be bolted to a bench. It is made by the Stover Novelty Co., Freeport, Ill.



SPOKE HOLE DRILLING MACHINE.

## Horse-Power and Longevity of Big Gun.

"La Nature" recently had something to say about the horse-power developed by a cannon in throwing a shot, and brought out some astonishing results. The article referred to states that an Italian 100-ton gun, with a charge of 550 pounds of powder and a shot weighing 2,000 pounds, will give an initial velocity of 523 meters (1,715 feet) per second. The length of time given during which the charge acts is less than one-hundredth of a second, and hence it makes the horse-power developed about 17,000,000; and adds that in some of the largest guns, with their heaviest charges, the horse-power will go as high as 24,000,000. These figures, it seems to us, are a little wild, and will bear revision; but even then the results obtained are sufficiently remarkable.

As we have not the data from which the statement was made up, we prefer to refer to the records of a 100-ton Armstrong gun. This gun, by the way, was made for the Italian Navy, and, after all, may have inspired the item referred to. The gun, with a projectile weighing 2,000 pounds, as above, and with a charge of 340 pounds of powder, gave a muzzle velocity of 1,475 feet per second. The length of barrel traversed by the shot was 30 feet, and if we assume the mean velocity to have been one-half of the muzzle velocity, then it traversed the 30 feet at the average rate of 737.5 feet per second, and the time occupied therefore was $30 \div 737.5 = .040678$, or, say, one twenty-fifth of a second. The total energy in foot-tons was 30,163, or 60,326,600 foot-pounds; and as this was developed in .04 second, the energy developed per minute at the same rate would be $60{,}326{,}000 \times 25 \times 60 = 90{,}489{,}000{,}000$, and this divided by 33,000 gives us 2,742,091 as the actual horse-power developed.

Taking, again, the foot-pounds developed, 60,326,000, and dividing by 33,000, we have 1,828 minutes at one horse-power; and as we have 1,440 minutes in a 24-hour day, it would only amount to 1.27 horse-power for the day. Allowing 2 pounds of coal per horse-power per hour, we would have $1.27 \times 24 \times 2 = 61$ pounds of coal to do the work done by the 340 pounds of powder, which shows that gun powder is not the cheapest fuel for power development.

It is understood that one of these guns is considered unsafe after 100 shots have been fired, and is put out of service; so that its entire active life is comprised in about 4 seconds, while steam engines jog along year after year with slight depreciation.

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Emory Stockwell, who had been superintendent of the Yale & Towne factory at Stamford, Conn., since 1868, died, on the 18th inst., of heart disease. He was an inventor, and had devoted considerable attention to improvements in time and other locks for safes.

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A. L. Ide & Son, of Springfield, Ill., signalized Lincoln's birthday celebration by sending, gratis, small but good photographs of Lincoln's home in Springfield.

# ELECTRICAL MACHINERY.

## The Present Development and Future Possibilities of Electricity.

BY WM. BAXTER, JR.

**In Two Parts - Part II.**

In the field of electric lighting, there is a much greater chance for extraordinary improvements than in that of the application of power. In an "arc" light, less than ten per cent. of the energy applied is converted into light; the balance passes off in the form of heat. In incandescent lights the efficiency is still lower, being about four or five per cent. We know, from fundamental principles, that all the energy of the current can be transformed into light; that is, we know that it is theoretically possible. But we do not know that it can be accomplished practically. We do not know that there is any practical barrier that would render the solution of the problem impossible. We are justified, therefore, in assuming that it is possible. Assuming that the problem can be solved, we are still unable to say what effect its solution would have on the electric lighting industry, or on the apparatus now used. If the solution should be affected by the use of machinery that would develop currents radically different from those now used, then the present generators would be of no value; but if the result is accomplished in some other way, the present machines would not be cast inside.

Tesla and others have been experimenting for several years in this field, on a line that would require the use of generators considerably different from those now in use; but others, who have been working in a different direction, could, if successful, use the present machines. All that has been accomplished in this line is so purely experimental, and so far removed from a practical form, that it is impossible, from the light it throws on the subject, to form any idea as to the probability of ultimate success, or of the direction in which success will be attained, if attained at all. The work of Tesla and others, within the past five or six years, has been almost entirely an elaboration of experiments that were first made over fifty years ago. Some new developments have been made, but, in the main, the advance over the work of former years has been in the way of carrying these experiments to a further stage of development, and also in producing the results on a very much larger scale. Therefore, as to the future of electric lighting, we are entirely in the dark; but, from the experience of the past in other fields, we may conclude that improvement will doubtless be made step by step, and that the probability that someone will at one bound land, practically, at the point of perfection is very slight.

If perfection in electric lighting should be attained within a few years, and the system involved the use of new systems of electric generators, the present machines would not be a loss, because they could be used as motors.

The storage battery is a subject of great fascination for most men, owing to the extravagant claims that have been made for it. If it were possible to place a battery the size of an ordinary hand-bag under the seat of a carriage, and have the necessary power to make a trip of fifty or seventy-five miles, then the future prospects of such a device would be very bright. But such results are only possible in the imagination of the scribes who from time to time give descriptions, in the daily press, of electric bicycles propelled by storage batteries, so small that they can be carried in the vest pocket. Great improvements in storage batteries are possible, but they will be in the line of increased durability, and not in the reduction of weight. We know, from actual experiments, the thermo-chemical value of about every form of matter that can be used for this purpose; we therefore can tell beforehand what would be the maximum theoretical duty of an element of a battery composed of any particular substance. Knowing this much, we know the limit toward which practice may approach, but beyond which it cannot go, just as we know the limit beyond which fuel economy in the steam engine cannot go.

Storage batteries will never be able to compete in the distribution of power with central stations supplying a district through feeders; but they have a field of their own, which they are now supplying to a limited extent, and in which they will be more extensively used as improvements tending to increase their durability are made. This field is that of adjuncts to the generators in power and lighting stations; that is, in supplying current during short stoppages of the machinery, and to equalize the load upon the machinery, as has recently been explained at length in these columns.

The most important and valuable of all the possible developments in this field that the future has in store, is that of the generation of electric energy by chemical action between cheap substances. The problem of the production of electricity direct from coal has occupied the attention of many of the most able electricians of the day, and has become familiar to the general public through the frequent allusions to it in print, especially in the electrical journals. As is well known to engineers, the best steam engines convert into work only about fifteen or sixteen per cent. of the energy set free by the combustion of the coal in the furnace of the boiler. It is further known that much better results are not possible, owing to the physical properties of water and steam. We also know that an electric battery will convert about eighty per cent. of the energy set free, by chemical action, into electric energy, and that the electric motor will convert over ninety per cent. of this energy into work. Therefore, of the energy liberated by the decomposition of matter in an electric battery, fully two-thirds can be converted into mechanical energy; whereas, the best results with steam engines are within one-sixth. In view of these facts, it follows that if we could make a battery that would use coal, or some substance equally cheap, we could effect an enormous saving in the cost of producing power. The production of such a battery is theoretically possible, but the practical difficulties in the way of its accomplishment are very great, and all the work that has been done in this line has failed to advance the subject far enough to enable us to see daylight ahead.

The production of such a battery would work a revolution in the industries of the world; how great a revolution we could not say, as that would depend largely on the form, dimensions and weight of the apparatus. The electric motor, with such batteries, would supersede the steam engine for all stationary work; but whether it would for marine work, would depend on whether the batteries were light and compact, or the reverse. The same considerations would determine the degree of its usefulness in railway work. If the batteries were small and light, they could be placed within the motor car, or in a separate tender, and the central power station and trolley lines and feeders would be dispensed with; but if not small and light, the trolley lines and station would have to be retained. In the latter case the batteries would be located in the station, and would replace the boilers, engines and generators. In any case, the saving in the cost of producing power would be very great, and the field of the electric industry would be enormously extended. Any calculations as to the future development of electricity, based upon the supposition that this problem will be solved, are too much like a dream to receive serious consideration. We know that the solution of the problem is within the limits of possibility; but as to its solution, we stand in the same position as we do in regard to finding the north pole—we know it is there; we know that many attempts have been made to reach it, without success; whether anyone will ever reach it, no one can tell.

In summing up all the foregoing, it may be said that the oft-repeated statement that electricity is in its infancy is only true in so far as its application to industrial purposes is concerned; that the developments of the future will, doubtless, be principally in the adaptation of electric machinery to new uses, and to improvements in its mechanical details; and finally, that although great improvements are possible in the field of electric lighting and that of generating electric energy, the prospects of anything very extraordinary being accomplished are not great; but if efforts in this line should be crowned with success, the effect would be to increase the value and usefulness of all kinds of electric machinery and all electrical industries.

## Electrotechnics—VIII.

### The Principles of Electricity for Practical Men.

BY FRANK S. MASON.

By means of the last formula we may calculate the flux of an electro-magnet of which we have the dimensions and the material of the core, and ampere turns of the exciting coil of wire. But it more frequently happens that we have the dimensions of the core and the magnetic flux given, and wish to estimate the ampere turns of the exciting coil or spiral. In such a case we proceed as follows:

22. TO CALCULATE THE AMPERE TURNS required to force a given number of magnetic lines through a magnetic circuit of known material and dimensions. First, it is to be noted that the value of $\mu$ for any substance is not constant for the substance, but varies with the degree of saturation—that is, the amount of magnetism generated in the core. In this respect it differs from the resistance of conductors to the electric current, which, as was pointed out in § 6, is constant for all values of the current, provided the temperature be kept constant. Owing to this variation in the value of $\mu$ we must first decide upon the desired degree of saturation, or density, so to speak, of the magnetic flux, and assign a corresponding value to $\mu$. This value of $\mu$ may be had from tables prepared from the researches of Hopkinson and others. Next, since the amount of leakage through the surrounding air is an uncertain factor, we must assume from experiment an allowance for error. If we know that of all the lines of force generated in the magnet core, only a fractional part $\frac{1}{v}$ pass through the armature, then we must generate $v\,N$ lines in the magnet core to force $N$ lines through the armature—that is, for instance, if only one-half of the magnetic lines generated in the core of the magnet pass through the armature, we must generate $2\,N$ lines in the magnet core in order to force $N$ lines through the armature.

In a dynamo we require to force a given number of lines, which we call $N$, through the armature. This same number must be also forced through the air gaps. As has been stated, some of the lines forced through the magnet cores do not go through the armature, but leak through the surrounding air; and to provide for this, we must force an increased number of lines, which we have called $v\,N$, through the magnet cores.

The method of procedure is to calculate separately the number of ampere turns required to force $v\,N$ lines of force through the magnet core, and $N$ lines through the armature and air gaps. Then the sum of these three determinations will give the total number of ampere turns required for the entire circuit.

Using the subscript rotation as before, we may let

$M_1$ = magneto-motive force required for the field cores;

$M_2$ = magneto-motive force required for the armature;

$M_3$ = magneto-motive force required for the air gaps;

$C_1\,S_1$ = ampere turns required for the field cores;

$C_2\,S_2$ = ampere turns required for the armature;

$C_3\,S_3$ = ampere turns required for the air gaps.

We will first determine the number of ampere turns, that is, the value $C_1\,S_1$, required to force $N$ lines through the field cores, and then multiply by v to obtain the value of $C_1\,S_1$ required to force $v\,N$ lines through those cores.

Going back to our original equation,

$$N = \frac{M}{R}$$

we have found that

$$M = 1.257\,C\,S \qquad (8, \S\ 19)$$

that is—for the field cores

$$M = 1.257\,C_1\,S_1$$

for the armature

$$M_2 = 1.257\,C_2\,S_2$$

and for the air gaps

$$M_3 = 1.257\,C_3\,S_3$$

Now for the field cores

$$R_1 = \frac{l_1}{A_1\,\mu_1} \qquad (9, \S\ 20)$$

Putting these values in their stead, we have

$$N = \frac{1.257\,C_1\,S_1}{\frac{l_1}{A_1\,\mu_1}} \qquad (10, \S\ 21)$$

which gives the number of lines of force forced through the field cores by $C_1\,S_1$ ampere turns, $l_1\,A_1\,\mu_1$ being the length, area and permeability of the cores.

But, as has been stated, we usually have $N$ given, and wish to find $C_1\,S_1$; and to do this, we must transform the equation and solve it for $C_1\,S_1$. To do this, we first multiply both sides of the equation by $\frac{l_1}{A_1\,\mu_1}$, giving

$$N\frac{l_1}{A\ \mu_1} = 1.257\,C_1\,S_1$$

We then divide both sides by 1.257, giving

$$C_1\,S_1 = \frac{N\frac{l_1}{A_1\,\mu_1}}{1.257} \qquad (12)$$

which gives the ampere turns required to force $N$ lines through the magnet core. But we wish to force $v\,N$ lines through the magnet core on account of leakage; and to do this we must multiply by v, giving a corrected value of $C_1\,S_1$—that is,

$$C_1\,S_1 = \frac{v\,N\frac{l_1}{A_1\,\mu_1}}{1.257} \text{ ampere turns.}$$

We must also force $N$ lines through two air gaps, and the same number through the armature. To force $N$ lines through the armature we require

$$C_2\,S_2 = \frac{N\frac{l_2}{A_2\,\mu_2}}{1.257} \text{ ampere turns.}$$

And to force $N$ lines through the air gaps, we require

$$C_3\,S_3 = \frac{N\frac{2\,l_3}{A_3}}{1.257} \text{ ampere turns.}$$

The total number of ampere turns must be the sum of the three—that is,

$$\text{Total } C\,S = C_1\,S_1 + C_2\,S_2 + C_3\,S_3$$

$$= \frac{v\,N\frac{l_1}{A_1\,\mu_1} + N\frac{l_2}{A_2\,\mu_2} + N\frac{2\,l_3}{A_3}}{1.257}$$

$$= \frac{N\left(\frac{v\,l_1}{A_1\,\mu_1} + \frac{l_2}{A_2\,\mu_2} + \frac{2\,l_3}{A_3}\right)}{1.257} \qquad (13)$$

Note that in all these calculations the centimeter is the unit of length, and the square centimeter the unit of area.

## Electrical Strabismus.

The work and standing of Prof. F. B. Crocker are well known, and the success of the Crocker-Wheeler motor sufficiently attests it. Nevertheless, a recent article by Professor Crocker, on "Coalless Cities," appears to us an admirable illustration of the tendency among even the best minds to run in grooves, and, when contemplating their favorite subject, to look upon the problems of the future from a one-sided standpoint.

This article contemplates the abolition of the direct burning of coal in cities by the introduction and distribution of energy from without, and it professes to compare the various methods which have been suggested for doing this.

The objections to the direct burning of coal within city limits are pointed out to be the expense of transportation of coal and ashes, and the vitiation of the atmosphere. This vitiation is of two kinds—that by carbonic acid gas, which, being transparent, affects the purity, but not the clearness of the atmosphere; and that by smoke or unconsumed carbon, which renders the atmosphere murky.

A comparison of hard and soft coal-burning cities will show at once that the

carbonic acid is a bagatelle compared with the smoke—which, indeed, is tacitly admitted by Professor Crocker, by the citation of Pittsburgh and London as horrible examples of the effects of coal-burning. He admits at one point that fuel gas would free the city from smoke and ashes, but nevertheless proceeds to contend that "the use of gas, however, fails to fulfill the conditions of the problem as laid down, since, as just noted, it vitiates the atmosphere to the same extent as the ordinary aboriginal method of burning coal under our very noses." Here the fact that the chief source of nuisance connected with coal is smoke, from which gas fuel would rid us, is ignored, and gas fuel is quietly saddled with all the objections which belong to coal—smoke included. Now, as a matter of fact, would not Pittsburgh and London consider their fuel problem satisfactorily solved if they could be rid of their smoke, and was not the introduction of natural gas into Pittsburgh hailed with acclaim for this very reason?

The article under discussion conveniently ignores the whole question of the cost of distribution; though, as will be seen by consulting another article in the same publication, the cost of transmitting 3,000 horse-power in gas and electricity under parallel conditions is as one to three hundred! The distribution of gas is objected to on account of the "danger of explosions and fires due to leakage of the gas," but the use of alternating currents at 10,000 volts pressure is contemplated without suggesting that danger may attend it!

Our author's one-sided electrical eyesight is, however, best shown in the manner in which he solves (?) the problem of electric heating If there is one application of electricity which, more than all others, seems to us intrinsically absurd, it is to heating—except, that is, to local heating, or under special circumstances. It is well known that general heating through electricity must be at least ten times as expensive in coal as when done directly. The main solution of this difficulty lies, according to our author, in the "steady and long-continued load due to heating," which "is favorable to the economical working of the generating machinery." In large stations the saving due to a steady load can hardly exceed ten per cent., and how this can make up an increased expenditure of a thousand per cent., only an electrician can tell. We are furthermore told that "it should be remembered that heating is required only during four or five months of the year, and many days of that period are sufficiently warm, so that little or no artificial heat is needed; consequently, the total expense per annum would not be very great." Ahem! Exactly! Of course, this fact applies to electric heating only; and, of course, it would go a long way to overcome the difficulty that ninety per cent. of the heat value of the fuel is wasted in electric heating. But, seriously, are we to be expected to believe that we shall ever see electric plants installed for general heating—of enormously greater capacity than would be required for all other purposes combined—the conditions being that they shall work under an efficiency of ten per cent. or less, and stand idle during seven or eight months of the year? Few things are certain about the future of electricity; but one thing is certain, and that is—that so long as its chief source is the steam engine, we shall never see it used for general heating.

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Editor American Machinist:

I note your criticism of my article on "Coalless Cities," which appeared in the January number of "Cassier's Magazine." The first point to which you object is the one-sidedness of my argument. But the criticism is really more biased than the article itself, because I stated both sides, and freely admitted the weak points of my scheme; but you give me no credit for doing so. You pick out the sentence: "The use of gas, however, fails to fulfill the conditions of the problem as laid down, since, as just noted, it vitiates the atmosphere to the same extent as the ordinary aboriginal method of burning coal under our very noses." In regard to this you say that I am wrong, because gas produces no smoke. But you fail to quote: "The conversion of all fuel into gas . . . . saves the trouble of handling coal, for example, and also frees the city from smoke and ashes; but the consumption of oxygen and the production of carbonic acid would still remain as great as with the ordinary use of coal." This last sentence appears ten lines above your quotation, the two taken together being a complete and fair statement of the case. I use the word "vitiates" to mean the consumption of oxygen and the production of carbonic acid, the results of which are far more injurious to health than the presence of a little dirt in the form of smoke, the latter being objected to merely because it happens to be visible. The important difference between city and country air is really due to the first-named effects of combustion.

When you say that "the article under discussion conveniently ignores the whole question of the cost of distribution," you yourself "conveniently ignore" two or three pages of a careful estimate of this cost, which, in fact, forms a large part of my article. In this estimate the cost of distribution is found to be small. Another of your statements is equally unfair, to wit: "The distribution of gas is objected to on account of the 'danger of explosions and fires due to leakage of the gas,' but the use of alternating currents at 10,000 volts pressure is contemplated without suggesting that danger may attend it!" My position in this case is perfectly correct, because the 10,000 volts are carried by underground conductors, and no one but the employés of the company, specially skilled and protected with rubber gloves, etc., would ever come in contact with them. My plan distinctly explained that the current would be transformed down to one or two hundred volts, which is perfectly safe, before it was supplied to any user; whereas the gas, with its danger of explosion, fire *and asphixiation* (which I did not mention), would go into almost every room. The public, through ignorance, greatly exaggerate the terrors of electricity, and are not aware that there are about as many deaths in New York City due to gas as there are in the whole world due to electrical conductors.

The unfairness of the strictures on my article extends to the last point which you make, regarding the excessive cost of electrical heating of buildings. I freely acknowledged the difficulties in this direction, and said, among other things: "Two or three of the ordinary electric lamps give ample light for a room of moderate size, but their effect on the temperature of the room is hardly perceptible, although it is a physical fact that they convert into heat practically all of the electric energy supplied to them." How could the case against electric lighting be put more strongly? But with current sold at two cents per horse-power hour, which is about one-fifth of present central station, electric heating is by no means preposterous. Even if coal continued to be used for heating large spaces during the fifty or hundred very cold days of the year, electric current would supply all the other wants in power, lighting, cooking and local heating—as, for example, in bed rooms, which only need be warmed for two or three hours a day. The final result would certainly be that coal would be used less and less.

In short, I find nothing to retract or modify in my article; and I feel as sure as before that some method substantially like the one I suggested will be adopted, and its results will be fully as far-reaching as those indicated. Electrical engineers are in a position to look with serene confidence upon the prospect, mingled with pity for the "old fogies," who will be forced to witness the steady progress of things which they consider objectionable and impracticable.

F. B. Crocker.

[Our desire to be fair in this matter is sufficiently shown by our sending the manuscript of our criticism to Professor Crocker before its publication.

Professor Crocker must have overlooked our statement that "he admits at one point that fuel gas would free the city from smoke and ashes." The gist of his position we take to be shown in his summing up; and we cannot read this in any other way than meaning that, after all, gas fuel has about all the disadvantages of coal. Vitiation may mean, technically, the production of carbonic

acid, as claimed by Professor Crocker; but in spite of this, we believe the chief objection to solid fuel to be the smoke it produces, and that gas fuel, by ridding us of this, would accomplish pretty nearly all that electricity could do, and without the enormous losses inherent in electric heating. Professor Crocker may direct his attention to freeing city air from carbonic acid, but what the public wants is riddance from smoke.

We are wholly unable to understand how any paper showing of the figures at which electrical current can be supplied, can overcome the fact that not over ten or twelve per cent. of the fuel burned can reappear in electric house radiators. Add to this the expense of production, distribution, administration, and wear and tear of plant, and it seems to us that the case against electric heating is proven. Moreover, it seems to us beyond reason to claim that the economies made available by moving the central stations without the city limits, would reduce the cost of current to one-fifth its present rate. Such a claim is certainly a severe indictment of the engineering which has located such stations as they are now!

We fear that Professor Crocker and ourselves must "agree to disagree" on this subject.—Ed.]

## LETTERS FROM PRACTICAL MEN.

### The Kane-Pennington Motor.

Editor American Machinist:

In reply to the pertinent questions of "Mechen," in issue of January 23d, I would say, first, that I am glad "Mechen" asks them, because they are founded on obvious discrepancies in my articles on the Kane-Pennington Motor; and, second, that I am very glad to answer them, as the correct answers to these questions are a matter of simple justice to Mr. Pennington, whose work is far enough out of the common gas engine track to claim positive originality; and the editor has, so far, given me, as regular correspondent, but one single and only instruction: that all matters presented by me should be treated with absolute truth and fairness, so far as my own personal limitations would permit. And I feel that, although using the utmost care to give only correct impressions of the Pennington motor, I have in some details failed to present the case in such clear light as to give the reader a wholly correct impression.

(1) "Mechen" asks: "Does a suspended motor-driven cycle making 1,500 revolutions per minute with naked cylinders, prove that the same machine could run on the road loaded to its working limit with naked cylinders?" I answer, No; certainly not. The needle valve was throttled down, so that the explosions were only frequent enough to keep the velocity at about a certain rate, as evinced by the vibrations of the suspended machine; the power developed was extremely small, of course—perhaps not more than one twentieth of 1 horse-power, and perhaps not even that. In the particular case to which I gave most attention, only one of the pair of cylinders was operative. The cylinder packing rings are made about one-sixteenth inch large in diameter before cutting open; this gives them considerable friction on the cylinder walls when new, and there was a new set of rings in the idle cylinder being worn down to a smooth bearing by the cylinder which was at work. The idle cylinder, with its rough rings, had to be constantly watched to keep it from injurious heating from friction. But I repeatedly saw this same machine run on the ground over bad roads at a speed which forbade any desire on my part to ride it, with a full explosion in each cycle of changes, as evinced by the regularity of its exhaust as it flew past me, without any overheating of its cylinders. Some of this riding was done by Mr. Pennington, who weighs 225 pounds; and while I cannot state the actual power developed by the motors in this case, I do not think it fell below 4 horse-power. In this guess I may be entirely wrong, but I give it as the best I have to offer. In this connection I shall next answer "Mechen's" sixth question:

(6) The unjacketed Pennington pair of motors weigh 17½ pounds, about. "Engineering" says 20 pounds, which was probably the weight of a pair of jacketed cylinder motors, and gave 2 horse-power at 500 revolutions per minue, which is quite in line with my own statement that these motors could develop 5 horse-power; as they would, according to the "Engineering" test of 2 horse-power at 500 revolutions, give 4 horse-power at 1,000 revolutions, and 6 horse-power at 1,500 revolutions, which is a speed quite within the safe possibilities in my own opinion. Mr. Pennington believes 2,000 revolutions per minute perfectly safe, and I saw no cause to doubt the correctness of this belief. I did see constant evidences that the motor was deficient in accuracy of construction. I am certain that no cylinders I saw were even a fairly close approximation to truly cylindrical shape; and it was sheer excellence of design, and nothing else, which gave the results which seemed so remarkable to me. Also in this connection, I answer "Mechen's" fifth query?:

(5) The engraving and drawings and description already given so completely illustrate the Pennington motor parts, that the gas-engine expert must be fully aware of the extent of the novelty of this machine. It must be borne in mind that seemingly slight changes in important machines have revolutionized the practice of the world in many instances, and that the simplicity of an invention and its obviousness (after it is made) are not detractions from the merit of the inventor. If Pennington's thin cylinder can obviate the need of the water jacket, or reduce the cooling effect needed to keep the cylinders at a safe temperature, so that a very little water used over and over again will keep the cylinders cool, so that the gas engine can become a perfectly suitable motor for cycles and other means of effecting individual translation at very high rates of speed, then the simple substitution of wrought-steel thin cylinders for the previous exclusively adopted gray-iron gas-engine cylinder is an invention of the first magnitude, and Pennington should be credited with the full measure of his usefulness in that direction.

(2) "Mechen" asks why tests were not made with better means. Because the boxes were waiting for the motors to be packed for shipment to London, and time would hardly permit even the making of the rude tests which were made, as the interests of possible foreign purchasers would admit of no further delay. In answer to the last part of this second question, I would say that it seems impossible that there can be any effect whatever produced by any spark except the one igniting spark; at the same time there were, undoubtedly, experiments which seemed to certainly show a different and better, much better, effect with the preliminary "long, thin spark," absurd as such an assertion appears on its face.

(3) In regard to the "Regan" engine effects, I absolutely cannot say more than I have already said. I did not claim that the ordinary Regan card should be compared with the Pennington cards, nor that the Regan card given was a fair ordinary gas-engine card, nor even that it was a fair Regan card; I said I did not believe it was a fair Regan card, and, of course, did not claim it was anything but about the worst card that a running motor could give. This Regan motor matter is an affair of individual interest to employés of the Kane Manufactory, and it would be grossly improper for me to detail it here.

(4) It is perfectly well known that a wholly reliable and satisfactory explosion-charge igniter is the one difficult feature of the gas engine. If the extremely simple low-cost igniter devised by Pennington can give the Pennington cards shown, and if it will work up to 2,000 revolutions per minute, day in and day out, and not wear out rapidly at such unprecedented speeds, then the Pennington igniter needs no commendation from my voice. I believe the Pennington igniter and the Pennington thin cylinder and the Pennington valves constitute a trio of elements new in form, and so well adapted to the functions for which they are designed, that they are of very great and permanent value. Time and use alone can determine the correctness of this personal belief. I hold it, and that is all I can say at present.

(7) Elaborate tests have been made, and highly-paid experts have reported on the

Pennington motor; not to the public, however, because the public did not pay for the tests; the Pennington motor is not yet of public interest—because it is not yet offered, commercially, to the public, and hence the public has no right to demand a demonstration of its merits. It was with the greatest reluctance that the matter was given to me for print, and only because publicity could not possibly be long delayed, was my first information given to me for the "Machinist." It is, however, impossible now to long delay a full publication of ultimate results, and upon those results the place of the Pennington motor in its class must finally depend, and on nothing else.

JOHN RANDOL.

## The Air Pumps of the "Arctic"—Marine Engine Practice.

Editor American Machinist:

Mr. J. G. Sayce, in your issue of January 16th., takes exception to my remarks in my letter of December 26th, 1895, saying that my "calculations are totally at fault." The only one I gave was one showing the probable velocity of the water in the 7-inch bilge injection pipe, and I meant exactly what I said, that it was "based upon my own knowledge," not upon "elementary text-books on hydraulics," to which he refers me. There is much confusion in those books, and because of it I took pains a few years ago to experiment myself in that line. I found that $V = 8\sqrt{H}$ and $H = \frac{V^2}{64}$, in which $V$=velocity in feet per second, and $H$=head in feet of water. These are the correct formulas, and are so given in some of the books.

The true head for 26 inches mercury is 26.4 feet, instead of 24, as I gave it; and I can take 10.4 feet for lift and friction and have left the 16 feet for producing the velocity.

The "vena contracta," as the old books have it, to which Mr. Sayce so feelingly alludes, is in the water outside the pipe, and does not reduce its capacity from what I have given.

I "said nothing about a strainer," because the practice was to lift it out of the way when using the bilge injection; it is merely an additional obstruction to the free passage of the water to the condenser; if the water is stopped by clogging the rack, the condenser gets hot, and there you are.

As to the "rose" on a bilge injection pipe, inside the condenser, although "the rose by any other name would smell as sweet," especially when pumping bilge water, I will state that I have served on eight ships, and have lately examined three others, which had nothing of the sort—only a hole in the casting, rather low down, to which the valve was bolted so as to avoid trouble by clogging.

The sea injection, of course, has some sort of a rose or scattering plate; and at one time I tried the experiment of comparing the effect of either.

I could see no difference. The bilge injection, with a good quantity of water in the ship and no rose, gave just as good vacuum at the same temperature as the sea injection with a rose. The steam is so sensitive to the action of anything colder than itself, and the air, which attains great bulk due to the low pressure of the condenser, flows by expansion into the barrel of the air pump, where the pressure between foot-valve and bucket is still lower, on the upstroke, and takes the water with it, assisted by gravity.

When the downstroke is made, the air and water pass up through the bucket; and on the upstroke again the air is compressed above the bucket, up to the atmosphere plus the head of water over the delivery valves. Most of the work is done here. I have diagrams showing a fine compression curve up to the point where the delivery valve opens; and calculations show that for each stroke the air pump was not more than one-sixth filled with water. Now, if the air entering the condenser "is carried in solution into the pump," our air pumps are much too large, and that rule-of-thumb engineer, Mr. Watt, who established the proportions, needs correction.

I do not know any way, except rules obtained by trial and experiment, for proportioning the parts of an engine. The "Arctic" had 635 square feet grate surface, which is a measure of the steam evaporated; and her sea injection pipe, it 1 inch larger than the bilge pipe, was 8 inches, and its sectional area 50 square inches, to admit the condensing water—and there were two of them.

We thus get a rule-of-thumb, $\frac{635}{100} = 6.35$;

or, say 6 square feet grate surface for each square inch of injection pipe, applying this rule, we find it to hold good in the work of two designers which I have lately examined—Vaughn Merrick, in the frigate "Wabash" and John Ericsson, in the monitor "Passaic," The "Wabash" has 338 square feet of grate; the two sea injections, 6 inches; bilges, 5 inches. The "Passaic" has 107 square feet of grate surface, the one sea injection is 4¾-inch, and two bilges 2¾ inches.

I have carefully examined the bilges of the timber-built ships "Minnesota" and "Wabash," and find that the constructors would never allow such a thing as cutting or leaving a well between the floor timbers, even for so small a thing as a 5-inch pipe. The floor plates are about 3 feet above the floor timbers, amidships, but there were half a dozen cross-keelsons between the fire-room and the bilge injection pipes.

Regarding "the precious Erie experiments," the following table shows the results, as published in the report, thirty-five years ago:

BOILER PRESSURE 23 POUNDS ABOVE ATMOSPHERE.

| Point of cut off | 1/12 | 7/10 | 1/8 | 3/10 | 1/4 | 1/8 | 5/8 |
|---|---|---|---|---|---|---|---|
| Lbs. of steam per I. H. P. per hour... | 38.03 | 33.82 | 32.67 | 34.68 | 34.47 | 36.77 | 41.38 |
| Comparative Result. . | 1.000 | 0.889 | 0.859 | 0.912 | 0 906 | 0.967 | 1.088 |

The gains by expansion in a single cylinder being balanced by greater condensation with the high measures, and proved by the feed-water measurement.

This was the experiment in which, as Dickerson said, "they measured the feed water as if it cost money." Of course, all the people who had cut-off traps and patents to sell, and had been diligently teaching, "The more the expansion the better the economy," proving it by fine indicator curves, set up a howl; but not a man-Jack of them all ever set up an actual experiment proving the contrary.

Mr. Dickerson, indeed, tried to, and, backed by certain men of money, produced the "Algonquin" and "Idaho" and "Golden Rule," which were fantastic and nightmare-producing failures. Instead of the rule-of-thumb, he used the rule of the whole fist—deep in the pockets of those capitalists.

The low efficiency of the engine of the "Michigan" at all points of the cut-off, was due to the low boiler pressure, not exceeding 25 pounds by gage; but it was considered good in her time (1844), and in passing I wish reverently to salute the shade of her designer, Mr. Copeland, who has just left us. To-day we have boat engines worked with 200 pounds. One of my sons, who is a very successful designer, lays out three crank triple-expansion engines with all valves working all the time with full travel and cutting off at five-eighths of the stroke, precisely as laid out by Mr. Isherwood thirty-five years ago, the object of both being simplicity of construction as well as economy.

WILLIAM H. HARRISON.

Braintree, Mass.

## Reamers Without Clearance.

Editor American Machinist:

The machinist who is familiar with the use of the micrometer caliper fully appreciates the importance of variations no greater than one-quarter of a thousandth of an inch. The continuous production of holes in iron castings, having a variation of diameter not exceeding the above fraction, is often of considerable importance in the economic production of machinery, without regard to other points of value, such as interchangeability, etc.

The subject seems to be somewhat of a problem with some of your readers. I will make this my excuse for trespassing upon your space. The first thing necessary is to fix upon the size of the hole best suited to the purpose, so as to avoid future changes. You will then be warranted in making a standard hardened and ground steel plug gage of size required. If this were for my own use, and the size of hole required were 1⅛-inch, the plug I would make 8 inches long—4 inches for ground part at one end, 2½ inches knurled part at the other, and 1½ inches of somewhat reduced diameter between the ground and knurled ends, where name, size in thousandths, and other matter required, would be stamped before hardening. Having one such gage, you will not perhaps require another of same size in a lifetime, the amount of wear being practically nothing.

The reamer is the next thing of importance, and decidedly the most interesting. The possession of the two virtues, faith and hope, may be required to enable you to put an ordinary straight-fluted jobber's reamer into shape for the purpose. Assuming the size required to be 1⅛-inch, the reamer to be found on the market is of no use, unless, perhaps, you should have the good fortune to find one about .010 above size. This should be ground to the required size in lathe or universal grinding machine, as you would grind any cylindrical piece of work, great care being taken to let the wheel cut very little as you approach the required size. When finished, each tooth will be cylindrical in shape, back of the cutting edge. After the cutting edges have become dull by use, they may be sharpened by careful grinding on face of the tooth. This can be done by hand, if the wheel be true, the hand steady, and the grip taken well towards the back end or shank part of reamer; the face of tooth being applied to under side of wheel of an ordinary, everyday emery-wheel stand. A little practice will be required to do this nicely, and it is well worth the trouble, as in this way many dull reamers may be sharpened without changing their size.

The manufacturers of reamers usually bring the teeth up to a sharp edge, leaving no cylindrical portion back of the edge. This for cast iron is a mistake, as the edges soon become worn and lose their size. It is true that such reamers will cut more freely; but as absolute size is the thing desired, they answer for a short time only. I have had a reamer in use for several years, which makes a hole so close to the gage that a slight difference of temperature—say 20 degrees—between it and the work is quite appreciable in the fit. This reamer has been used on a good quality of cast iron only, and not allowed to come in contact with scale.

The holes are first bored to size, leaving but two or three thousandths for the reamer to take out. Tools of this description should be made of the very best quality of steel, and left as hard as possible. After being hardened, they should be heated to a degree just short of showing any color. This should be done before the tool is ground. If done after the grinding process, it will in all probability no longer be true. In other words, a piece of good tool steel, made as hard as possible and then ground true on centers, will, in all probability, upon being reheated to 300 or 400 degrees, change its shape or become out of true.

T. R. ALMOND.

Brooklyn, N. Y.

### Setting an Angle Plate.

Editor American Machinist:

I notice in your paper of the 6th, a communication from Mr. Walter Gribben, of Brooklyn, N. Y., on how to set an angle plate for duplicate bearings. I have had about the same kind of job. The way I did it is this, and I think it a much quicker way: Set angle plate on face plate of lathe, straight with T-slots, and drop it off center as much as is needed; strap on your bearing, or whatever it may be; put a tool in tool post, so as to get both ends of bearing the same distance from center. Now bore out as many as you want; then, take a piece of scrap cast iron with one side finished, strap that on angle plate, bore out the same as bearings—one inch thick is enough. Now, when you are ready to bore out the next lot, take an expansion mandrel or turn a solid one so as to be a good tight fit in the cast-iron piece; put on your face and angle plate, leave centers in head and tail stocks, put your mandrel in the cast-iron piece—then put it on your centers. Then all you have to do is shove your angle plate up against the cast-iron and make it fast; it is bound to bring them all alike.

G. F. WATSON.

Port Richmond, N. Y.

### Latch on Rim Driller.

Editor American Machinist:

I have read with much interest Mr. Dolnar's series of articles, but was somewhat disappointed in the indexing mechanism of the rim driller as described in the January 23d issue. It seems to me the second lifting of the latch might be avoided in a comparatively simple way by having the cam pin slide endwise in the latch, with a spiral spring behind it, and then beveling the heel of the cam in a vertical plane. There is usually a contrivance similar to this in a snail or repeating strike movement of a clock, to prevent unlocking the strike or breaking the parts in the event of the hands being turned backwards.

WALTER GRIBBEN.

Brooklyn, N. Y.

### A Government Job.

Editor American Machinist:

While at the Marine Engine Works, the boys used to do a lot of Government work; not the kind that is done at the "Cramps'" shipyard on the new cruisers, but work for We, Us & Co., building gages, try squares (?), "morphodite" calipers, etc. As long as the jobs were confined to the 'prentice boys, and done out of "hours"—that is, before the whistle blew in the morning, or at noontime—the boss did not take much notice of them; but let him catch a journeyman at it, and it was "Good-by, journeyman."

I didn't do much of it myself—I was too lazy, and because the tools did not suit me after I got them done. I did, however, do a lot for the rest of the boys in this way. I was running four shapers, and had two 'prentice boys; and one of the men got an order from the foreman for me to plane out a pair of V-blocks for him, and I made thirty-seven pairs of them on that same order. We had some castings that were just right, and all I had to do was to plane the V in them; and if the boss should have happened to see me (which he never did), why, I had an order to make them.

We had a journeyman in the shop, an extra smart fellow he was, too, and a mighty man at the vise; we will call him "Frank," that will do as well as any name. Well, Frank wanted a bicycle, and, like lots of the rest of us, he didn't want to pay out the cash. This was just after the panic of '73, and we all were feeling pretty poor. Bicycles had just begun to come in style, and Frank thought he could build one; as he was a vise-hand and seldom did any lathe work, it looked to me a poor show, but Frank started in.

There was a lathe set near the shapers and right at the foot of the stairs, and through the side of the stairway there was a big knot-hole. Now, the foreman wore a suit of navy-blue cloth and the rest of the men wore the regular light-blue overalls, and Frank could tell, by watching the hole, whether it was the boss or one of the men. There was no foreman on the first floor, and only one flight of stairs in the shop, so when the boss was upstairs Frank knew just where to look for him to come in.

He would put his job in the lathe, and set a piece of finished work, such as he sometimes had occasion to do, on the end of the lathe and where it would meet the eye of the boss as he came down the stairs; then he would stand with his hand on the tail-stock hand wheel and his eye on the hole in the wall, and when he saw the navy-blue suit pass the hole he would give the hand wheel a whirl and let the work out on to the floor, and when the foreman came down he would have the job of finished work in his hand, just getting it ready to set in the lathe.

There was one fellow who wore a pair

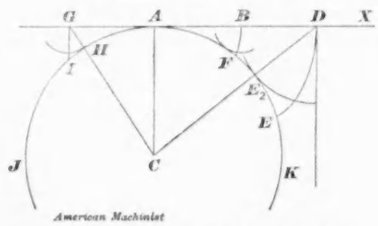
of new blue overalls and Frank could not tell them from the navy-blue, and when he did get fooled by them how he would swear!

Some of the larger parts, as the head and forks, he had to do outside, but the great bulk of the work was done at the Company's expense.

While I wish it understood that I utterly condemn the idea of his doing the work as he did, I could not but admire the skill he displayed in avoiding detection, which, had it been expended in a proper channel, would have paid for a wheel twice over.

Frank is now, or was—the last I heard from him—foreman of a large shop that has the reputation of being one of the strictest in the country, and should this meet his eye I hope he will remember.

A. P. PRESS.




## The Curvature of the Earth

Editor American Machinist:

If $A\,J\,K$ be a circle with its center at $C$, and $A\,X$ be a line unwound from the arc $A\,K$, while under tension, the point $D$, in the line, will have developed the involute $D\,E$; the point $B$, also in the line, will have developed the involute $B\,F$; and we have $A\,B^2 : A\,D^2 :: B\,F : D\,E$.

If $G\,A$ be made equal to $A\,B$, $G\,H$ will be the external segment of the secant $G\,C$ of the angle $A\,C\,G$. $G\,I$ will be the rectangular ordinate from the point $G$ to the curve. $G\,H$ is not equal to $G\,I$, and neither one is equal to $B\,F$. When $G\,A$, or $A\,B$, is small relative to $A\,C$, $G\,H$, $G\,I$ and $B\,F$ may be so small that their differences are unimportant. When an arc as $A\,E$, is greater than the radius, $G\,I$ is impossible, and $D\,E_2$ is much less than $D\,E$. The curvature of the earth is not, therefore, as the squares of the distances.

SUPERANNUATED.

## Water from the Condenser Getting into the Cylinder—Belt-Driven Governors.

Editor American Machinist:

There are so many erroneous ideas about the nature of a vacuum and its effect in a condensing apparatus that it may not be uninteresting to mention some of them.

As one illustration, I would refer to the cut, which shows a design that is intended to imitate the well-known Bulkley condenser, except that this depends on an air pump to produce the vacuum and clear the condenser of water.

Now, there are several reasons why a condenser will give trouble if it depends on an air pump to get rid of the water, any one of which will cause the water to rise in the exhaust pipe and wreck the engine. One favorite device to prevent this is to put on what is termed a vacuum breaker, which is a device that opens a small air valve and breaks the vacuum, thus stopping the flow of water unless there is a head to the same. This should open into the steam space above the water, as, if it should open below the water, it would lift the water and probably do damage.

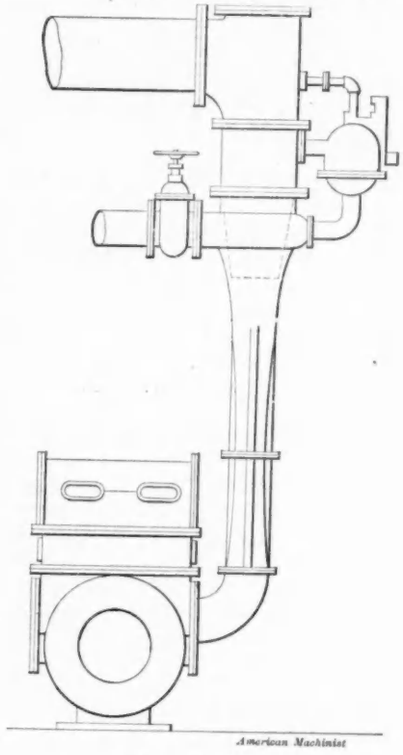
In the cut, the large pipe at the top is the exhaust from the engine, and the pipe lower down, with the valve, is the cold water inlet, the water coming down outside the cone (shown in dotted lines) and meeting the steam below.

The party that designed this describes the action as follows: "The water that gives trouble is sucked up around the edge of the cone and through the exhaust pipe into the cylinder and thence into the engine. The vacuum breaker (shown on the right) opens when the water reaches that point, and breaking the vacuum, prevents any trouble.

In the first place, the vacuum cannot suck the water around the edge of the cone. It cannot suck the water at all, so as to lift it. If any one wants to see how such a thing is impossible, let him take a glass tube, close one end air-tight, fill it half full of water and suck on it, and see how far he can lift it. An ordinary man sucking on a vacuum gage can show from 12 to 18 inches, but he would find that whatever he can do in this direction, he would make no impression on the water in the tube. It would be the same with any shaped vessel that had no connection with the air at its under side. If it were possible to suck the water around the edge of the cone the breaker would not be affected, as it would not flow into that, but would go directly into the engine. The breaker cannot be affected unless the water fills up and floats the hollow ball. To do this requires the condenser to fill up to that level. Unless there is a good strainer on the water pipe leading to a condenser of this type, the dirt brought in is liable to accumulate at the edge of the cone and choke up the water passage, and if such a thing were to happen with the breaker as shown, the extra pressure would cause the water to rise into the breaker and stop the flow of water. So much for a vacuum breaker in that position.

We often hear of the water being sucked up into the engine. Such a thing is impossible, as stated above. There is only one way that it can get there, and that is by the condenser filling up. This may be caused in several ways. If the pump should stop and the vacuum be still maintained, the condenser would fill up as well as the engine. A case came under the writer's notice, a short time ago, where a young man not very well conversant with steam was finishing out a run, and, according to custom, allowed the steam to get low without paying any attention to the pump, with the result that as the steam decreased the speed of the pump decreased with it, and while it maintained a partial vacuum, it did not pump out all the water that came through the injection valve; the condenser filled up, as did the cylinder partially, and the relief valves were all that saved the engine.

Some air pumps are duplex. The valves




A CONDENSER.

on this class of pumps depend on the motion of the piston on the opposite side; and if anything happens to the piston on one side, from getting a little air or something of that sort, it makes a short stroke on the other side, and soon both sides are mixed up. This is bad enough with a pump pumping cold water; but when it comes to a pump pumping water out of a condenser, it means that sufficient vacuum is kept to insure a flow of water into the condenser, but that it is taking too short strokes to pump it out, and ruin follows. This is the history of a number of this class within a few years.

The direct-connected air pump has its list of breakdowns from the same cause, the engineer not shutting off the injection water when shutting down.

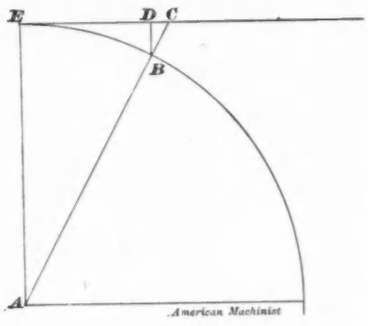
---

A correspondent mentions a case of an engine having a shaft governor, having the load all thrown off and then all thrown on, and in no case did the engine run

away, and the speed was very steady. It has been the practice to do this with belt-driven governors hundreds of times every day in every rolling mill throughout the world for generations.

W. E. CRANE.

Waterbury, Conn.




### Curvature of the Earth.

Editor American Machinist:

Our friend Porter, in your issue of January 30th, has proved altogether too much for the good of his "steam jacket" on steam cylinders.

He has shown us that, to make up for a little deficit of work in the steam cylinder, due to loss of heat by radiation, we must dip into the boiler for more steam; but he does not show us that this extra draft for steam is any less than that lost by radiation from the cylinder, so we are not informed as to the economy of the steam jacket.

On the contrary, it is generally conceded by experienced steam users that the steam jacket fails to meet expectation on the score of economy, and, instead, they apply the "dry jacket," consisting of asbestos, mineral wool, or even a casing of wood inclosing dry air about the cylinder.

True, the live steam jacket secures a little more work done in the cylinder. But when we recollect that in consequence of greater and more constant temperature in the surface of the cylinder, the loss is greater from radiation, precisely as the flow of water is greater from a high head than a low one, we can see how the steam jacket can fail of being economical.

But the dry jacket, by retaining most of the heat given to the cylinder in the early part of the stroke, when the temperature is above the mean, to be given out again near the last part of the stroke, when temperature is below the mean, makes a genuine saving of most of the heat that would otherwise be lost by radiation. Give us the dry jacket every time.

---

Our friend Quirk has shown us that both himself and the party whom he would criticise, stand about abreast with each other in the question of the "earth's curvature." They have both shown us that "a little learning is a dangerous thing." The fact is, the law or fact stated, that "the deflection varies as the square of the distance," does not pertain to the circle at all, but to the parabola. To this curve the law or rule applies with rigorous accuracy; while to the circle, as in the curvature of the earth, it applies only approximately, and but for a small, very small part of a quadrant.

The parabola is the arc of a circle at its vertex, but at the other extremity of the curve—or at the distance of infinity from the vertex, it is a right line—and between these limits its deflection from a tangent through the vertex varies according to the above law. So that the parabola will coincide with the earth's curvature for a little way from the point of contact; but as soon as the earth's radius begins to diverge from the direction of a perpendicular to the tangent of the curve (see figure), the law begins to fail with regard to the earth's curvature—*i. e.* as soon as the arc *B E* is so large that the line *A C* begins to diverge from *B D*, which is always supposed to be perpendicular to the tangent *E C*.

If the arc *E B*, or distance *E D*, were 60 geographic miles, then the angle *C B D* would be 1 degree; so that *B D* would be slightly shorter than *B C*—*i. e.*, the law would begin to fail. *B D* would be about 1 foot shorter than *B C*.

At 120 geographic miles, *B C* would diverge 2 degrees from *B D* and it would be over 2 miles long, and it would be greater that *B D* by some 8 feet.

From the above, we see that for all purposes of leveling, or of finding the distances at which lights are visible, or how high they must be to be visible any given distance, the law is practically correct for the circle of the earth.

OBSERVER.

### Dividing Circles.

Editor American Machinist:

If Mr. Newton, when his dividers fell short ¼ inch of going around his circle (see February 6th issue), had not guessed at how much to hone off the points, but, instead, had stuck another circle concentric with the first one, only $\frac{1}{12}$-inch smaller in diameter, and then stepped around that with the original setting of the dividers, I think they would have stepped off just about fifty divisions, with the further advantage of not having the old marks to bother him. Mr. Newton seeks to avoid falling into the old marks by starting in a fresh spot, or going around in the reverse way; but it seems to me there would be at least one spot in the circle where the old and new divisions would coincide, if both were stepped off on the same circle. By striking a new circle, either larger or smaller, according as we overrun or fall short, the accumulated error only has to be divided by 3.1416 to get the difference in diameters (or by 6.2832 to get difference in radii), instead of being divided by the whole number of divisions to get the amount tc open or close dividers. This is not strictly true, of course, as it supposes the dividers to follow the circumference of the circle, instead of stepping off a series of chords. However, it is practically exact for high-numbered divisions, and this is the field where its usefulness is most likely to be appreciated.

WALTER GRIBBEN.

Brooklyn, N. Y.

### Standard Catalogs and Standard Section Lining.

Editor American Machinist:

While the public is so kindly disposed to standards in catalogs, etc., would it not be a good time to again urge the advisability of adopting a standard for section lining? I find the present practice very confusing, as the sectioning one draftsman will use for wrought iron will represent brass according to another's code. I should very much like to hear the views of others on the subject. As for myself, I use the United States Navy Department standard, as given in "Haswell's Pocketbook."

One word more. How many draftsmen know of a ruling pen now in the market, which can be set at two different widths of line, and will draw either at will, by pressing a spring nib? It can be used to great advantage in either cross-sectioning or shading.

GEO. A. FAIRBANKS.

Watertown, N. Y.

[We think one kind of section lining is sufficient; and that where it is necessary to designate the material, it is easier, simpler and better to letter it "steel," "brass," etc.—Ed.]

### Providence Association of Mechanical Engineers.

Amongst the younger local engineering societies that seem likely to be beneficial to their members, is the Providence Association of Mechanical Engineers.

The first preliminary meeting, looking to the organization of this association, was held in October, 1894, and an organization was effected and the first annual meeting held in January, 1895, at which meeting A. A. Fuller, superintendent Builders' Iron Foundry, was elected President; E. P. Holly, of Holly Steam Engineering Co., Vice-President; Wm. W. Chase, Treasurer; F. N. Connet, Recording Secretary; and Z. R. Tucker, Corresponding Secretary. The councillors are—Geo. R. Babbitt, J. E. Wilson, M. H. Bronsdon, S. D. Burlingame, W. G. Burnham and Q. B. Cruickshank.

The objects of the association and its constitution are much like those of the A. S. M. E., and a meeting is held every month, except in July and August. The society now has thirty-one Senior and five Junior members.

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### Metric Screw Threads.

Among the strongest evidence we have recently seen bearing upon the question of the probability of the adoption of the metric system is to be found in "Engineering" (issue of January 17th), in which the subject is treated, and the following unqualified statement is made: "We regard it as an absolutely foregone conclusion that the metric system will be adopted here [Great Britain], and the only points open to discussion are how the transition can be made most easily, and how far can advantage be taken of the change to establish certain international standards, which would have great commercial value."

Our contemporary then goes on to discuss screw threads in connection with the metric system and thinks advantage should be taken of the inevitable change to systematize the screw threads of the world, and that it is better to do this before rather than after the metric system is made compulsory, as it thinks will be done in Great Britain.

Though no direct recommendation is made, yet the thread recently adopted as the standard in France is commended, and this thread, as our readers know, conforms closely to our own Sellers' thread; being, in fact, the same except for the modifications necessary to make it conform to the metric system. On page 423, '95 volume, we have shown this close agreement between our own and the new French thread.

It is hard to imagine a more fruitful source of annoyance and expense to machinery manufacturers than another change in our system of screw-threads would be, and we think it is likely to be a long time before such a change can be made, if ever; yet it is not inconceivable that conditions may arise that will render such a change much more desirable than it now appears to be.

For instance, if practically all other prominent machinery building countries should adopt such an international system, which is by no means out of the range of possibilities, and our foreign trade in machinery should grow to be an important factor in our national prosperity, which also seems not impossible, then it might easily happen that such a change would become advantageous to us. Though we cannot find that the metric system is making much headway in this country amongst machine constructors, it cannot be denied that it is gaining ground in other countries, and every inch (or rather we should say centimeter) gained by it makes its adoption both more necessary and more probable.

This makes it clear that our professional societies, notably the American Society of Mechanical Engineers, American Association Railway Master Mechanics, etc., should join any conference that may be properly proposed for the purpose of securing intelligent and wise action on the matter if action is to be taken.

We are not now discussing the desirability or otherwise of the metric system generally; or of metric screw threads in particular, but only advising that the actual state of affairs be clearly recognized in order to enable us to look after our own interests.

### Contracts for Patent Royalties.

Though most manufacturers are undoubtedly conscientious in the matter of carrying out agreements made with inventors, there is occasionally some complaint on this score, and in some cases these complaints are undoubtedly well founded.

Taking Queen & Co., the instrument makers, of Philadelphia, for instance, we know of three different cases in which this concern has failed and neglected to carry out its plain agreements made with inventors—agreements to manufacture and place upon the market devices invented by engineers, who supposed that, as they were dealing with an old and well-known house, agreements made with it would be carried out in good faith.

So far as we can ascertain, there was no good excuse or reason in any of these cases for failure to live up to agreements, and the failure to do so resulted in loss to the inventors.

Our readers, many of whom occasionally invent things, will do well to be cautious in making agreements for manufacturing and for payment of royalties.

### Straightening Cast Columns.

Our worthy contemporary, "The Engineering Record," is somewhat disturbed that we should publish "without censure, but as an interesting operation," an account of a method of straightening cast-iron columns, and seems to hold the opinion that because there are places and circumstances in which a straightened cast column should never be used, therefore nothing should be known about how to straighten them.

We cannot agree with this view of the case, because while we all know that it is much better that a cast column should be straight when cast, there are circumstances, and degrees of curvature, that make the straightening of them, by the method described, perfectly proper.

None of us who has his eye-teeth cut expects that cast columns, as usually made, will often be entirely free from "injurious internal strains;" and, in fact, the methods sometimes adopted in foundries to keep columns stright while cooling probably cause as much internal strain as the method of straightening referred to might cause; and it is even conceivable that a column might actually have less internal strains after being subjected to this operation than before.

We have published formulas for alloys adapted to filling blowholes in castings. We think there are circumstances where the use of such an alloy for that purpose is proper; but our publication of the formula "without censure" does not make us responsible for its misuse—*i. e.*, its use in places and under circumstances where considerations of safety would call for a new casting.

### Continuous Brakes on English Railway "Goods" Trains.

The "Mechanical World" (London) for January 31st gives a brief account of three recent accidents with goods (freight) trains on the London & Northwestern Railway—two of them being attended with fatalities—which, it correctly states, would have been prevented had the trains been fitted with automatic brakes, "as certain well-intentioned individuals maintain they should be." The "Mechanical World" proceeds to make out what it calls a "fairly good case against the reasonableness of requiring railway companies to fit continuous brakes to their goods trains." In doing this it states that, to carry out the plan, "goods wagons would need to be equipped with more elaborate and expensive braking appliances than those used on the majority of lines for express passenger traffic." It also refers to the "confusion which would occur in making up a long goods train in which wagons of perhaps half a dozen different companies might possibly be found, each set being fitted with a different form of brake." Points are also made of the "enormous cost of fitting continuous brakes, and the greater wear and tear with increased risk of failure." All of which goes to emphasize one point in which American railway practice leads the world. Our track and signal systems may be and doubtless are, on the whole, inferior to the English; but it is doubtless also true that the efficiency of our braking appliances goes far to neutralize the defects of the signal system.

The economic advantages of an effective braking system do not seem to have impressed themselves upon our transatlantic cousins. The increased safe speed of freight trains, due to their being under complete control when fitted with the Westinghouse brakes, is here well known, as well as the smaller train crews necessary to operate them. These advantages, together with the increased security from accident, are so great that it is considered settled by the railroad men of this country that automatic freight brakes are one of the most profitable of recent railroad improvements. Several of the objections raised by our contemporary are, in fact, mere bugbears, especially the fear of "increased risk of failure in operation." Continuous brakes are not, of course, infallible; but that their general tendency is to largely increase the degree of security, there can be no doubt.

The question of cost has not been found prohibitive in this country, it being, in fact, considered as a profitable investment. The result is a rapid advance in the equipment of our freight cars with the continuous brakes, which advance is obviously destined to continue until the improved brake is as universal on our freight as it now is on our passenger cars.

Altogether, the railroad brake question is one which Americans can contemplate with the equanimity of undoubted superiority.

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Operations now going on in connection with what is called the "Brua milling patent" are calculated to still further and unjustly prejudice the minds of the rural community against the patent system. Agents of those to whom this patent has ostensibly been assigned seem to be making a business of frightening owners of the smaller flouring mills located in country districts, into giving up various sums of money to avoid damage suits for infringement of this patent. Their principal means of accomplishing this is by misrepresenting court decisions regarding the patent. It is, of course, bad enough that men should be swindled out of their money in this way; but it is made worse by the familiar fact that all such games are charged by their victims, not against the swindlers so much as against the patent system. The association of inventors could probably do no more useful work than to undertake the exposure of all such swindles under the name of patent rights, and to inform those interested of the true state of affairs.

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An interesting application of the storage battery is that proposed on the experimental electric equipment for the Thirty-fourth street branch of the elevated railroad of this city. It is, of course, desirable to get the elevated trains up to speed as quickly as possible. This calls for a heavy current until speed is attained, after which the current required to maintain speed is much less. To meet this condition, it is proposed to equip each electric locomotive with a storage battery which will supply the surplus required for starting. After speed is reached, the current for the locomotive will be switched off from the battery, the locomotive drawing from the conductors only. During this time, and also during the time the train is standing at the station, the battery will be recharged from the main current. The result will be to equalize the demand upon both main conductors and central station, thereby reducing the capacity required, in both conductors and station, to the average consumption. Without the batteries, these capacities would have to be equal to the maximum demand.

## Questions and Answers.

*Name and address of writer must accompany every question.*

*Questions must pertain to our specialties and must be of general interest.*

*We cannot undertake to answer questions by mail.*

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(36) J. H. T., Chicago, asks: Could a small model gas engine—say, 1½-inch bore—be made to work as well as a small model steam engine of about the same size, or could they be made to work at all? A.—We think that such a gas engine could be made to work, though there would probably be some special difficulties owing to the necessarily small apertures, which would have a greater tendency to clog by deposit within them than is the case with larger sized engines.

(37) I. H. McK., Germantown, Pa., asks: In what issues of your paper were the articles upon "Perspective Drawing" published, and are they still in print? A.—We have lately received several inquiries similar to this. We do not know what articles are referred to. In 1889, Frank Richards gave us a few articles upon the principles of isometric drawing. The dates were February 21st, March 28th, April 18th, May 16th and June 27th. The numbers are not now procurable, except in the complete volume for the year, which can still be furnished.

(38) Cav., Phila., asks: In steam-fitting, which is the proper way to place a valve—with the steam pressure tending to hold the valve on its seat, or tending to assist the opening of the valve? A.—Assuming the question to refer to the familiar globe valve, we would say that it should be placed so that the steam pressure would come under the valve. When the steam was shut off, the stuffing box would then be relieved of pressure, and, if necessary, it would always be possible to repack the stuffing box; while with the steam above the valve, it could not be done. It is also much easier to open the valve; and if the opening required is small, it is easier to adjust it if the pressure is under the valve. With the pressure above the valve, it is difficult to adjust the opening very fine, as the slack of the valve on the spindle allows it to jump a little one way or the other; while with the pressure under the valve, the slack or lost motion is always taken up by the steam pressure.

(39) A. F., Pittsburg, Pa., writes: I have a 20 x 24-inch engine, running 185 revolutions, with an 8-foot pulley, driving a 300 horse-power generator having a 34-inch pulley, carrying a 30-inch double belt, the pulleys being 17 feet between centers. When loaded, the belt slips considerably. By turning the engine around I can gain 7 feet between centers, but it will be rather expensive. What would you advise—cover pulley, get a link or perforated belt, or turn engine? A.—We would not advise you to turn the engine. Your present distance between centers is probably not much shorter than the average practice. The present arc of contact upon the small pulley being 162 degrees, the contact after turning the engine would only be about 168 degrees. It would also be necessary

to run the engine the other way, which in some engines would be an expensive thing to do. You do not say whether the slack of the belt is above or below. We would cover the smaller pulley with leather, and after that, if necessary, would put on a 24-inch double belt outside the present 30-inch belt, running both belts. This would throw more strain upon the generator bearings, and might cause trouble in that way.

(40) C. E. S., Chicago, asks: How many cubic feet of air, under a pressure of 6 atmospheres and a temperature of 60 degrees, will it require, in expanding, to produce as much cold as the melting of 25 pounds of ice in 24 hours? Also, how many cubic feet of air, under a pressure of 3 atmospheres, would it require to produce the same effect? A.—The latent heat of fusion of ice is 142.65, or this number of units of heat are required to convert 1 pound of ice at 32 degrees into water at the same temperature; so that for 25 pounds of ice, $142.65 \times 25 = 3{,}566$ heat units will be required. We do not see how the time, 24 hours, can have anything to do with the question. The weight of 1 cubic foot of air at atmospheric pressure, and at 60 degrees, is .0764 pound; and the weight of 1 cubic foot at a pressure of 6 atmospheres, and the same temperature as before, is .4584 pound. If this air be allowed to expand to a pressure of 1 atmosphere, making 6 cubic feet of free air, the theoretical fall of temperature will be 211 degrees, or to $-151°$; and if the air after expansion is to resume its normal temperature of 60 degrees, it must do so by absorbing heat from some surrounding source. The specific heat of air under constant pressure is .2377; and the weight of the volume with which we are dealing being, as stated above, .4584 pound, the heat required will be $.4584 \times 211 \times .2377 = 22.99$, or, say, 23 units of heat. As we found above that the melting of 25 pounds of ice would require 3,566 heat units, then $3{,}566 \div 23 = 155$, the number of cubic feet of air at a pressure of 6 atmospheres, which, upon re-expansion to a pressure of 1 atmosphere, would require an equal amount of heat to restore it to its original temperature, or, in the language of the question above, "would produce as much cold." Remembering that we have here been dealing with air at a pressure of 6 atmospheres, we have $155 \times 6 = 930$ cubic feet as the volume of free air that must have been originally compressed in this case. We may now consider the case of air under a pressure of 3 atmospheres. In this case the fall of temperature upon re-expansion would be 142 degrees, or from 60° to $-82°$. The weight of the air in this case, 1 cubic foot at a pressure of 3 atmospheres, would be .2292 pound, so that $.2292 \times 142 \times .2377 = 7.74$ units of heat required to restore the temperature after expansion; and $3{,}566 \div 7.74 = 461$, the number of cubic feet of air at a pressure of 3 atmospheres, that upon re-expansion would have a cooling effect upon its surroundings equal to that of the melting of 25 pounds of ice; and $461 \times 3 = 1{,}383$ would be the number of cubic feet of free air in the case. We have answered the above question as literally as possible, as we do not know the precise intent of the questioner. Our solution does not show the volume of air required to freeze any given weight of water, and it is evident that the proportionate volume would require to be much greater than here indicated, as the temperature of re-expansion could not be permitted to rise above 32 degrees, instead of rising to 60 degrees, as we have assumed, and as was warranted by the wording of the question.


## BUSINESS SPECIALS

*Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.*

Gear wheels gear cutting. Grant; see page 36.

Power Hammers. Beaudry & Co., Boston.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Patents, write Walter Donaldson & Co., Wash. D.C.

Model making and electrical experimental work. F. W. Gardam & Co., 58 Ann st., N. Y.

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Duplex and special gear cutters, counterbores, cutter and surface grinders, vertical millers, hand punches and shears. R. M. Clough, Tolland, Conn.

Patent Soliciting of High Class.—D. Walter Brown, Counsel in Patent Cases, 111 Broadway, New York. Send for "Brief History of Patent Legislation."


## The Expression of Arithmetical Rules by Algebraic Formulas.

**In Three Parts—Part III.**

CORRECTION.

In the second article of this series which appeared last week, page 186, second column near the middle, appears the following: "By dividing one by the other obtain $R$." This should read "obtain $N$."

One other subject remains to be explained—namely, the transformation of equations, which was alluded to at the start as the second great advantage of algebra.

To illustrate this, return to the original belting formula—namely,

$$x = \frac{abc \times 3.1416}{600}$$

In this, the diameter of pulley, width of belt and number of revolutions are supposed to be given, in order to find the horse-power. Suppose the horse-power, diameter and speed of pulley are given, and the width of belt is to be found. In this formula, $b$ stands for the width of belt, and all that is necessary in order to adapt the formula to the new conditions, is to so transpose it that $b$ shall stand alone on one side, while the other letters, including $x$, shall all be upon the other. In transposing a formula, we must always remember to do such things only to the equation as shall leave it an equation. Thus:

If we add or subtract the same or equal quantities to or from both sides of the equation, the result, obviously, will still be an equation.

If we multiply or divide both sides of an equation by the same or equal quantities, the result, obviously, will still be an equation.

It results from this last, that if we square both sides of an equation the result will still be an equation, since to square the left side is to multiply it by itself, and to square the right side is to multiply it by itself; and the two sides being equal, we will, in squaring both sides, simply multiply them by equal quantities. Thus, if $a = b$, we shall also have $a^2 = b^2$; or if $a+b=c-d$, then $(a+b)^2=(c-d)^2$.

In the same way, taking the square root of both sides will not destroy the equality, and so also for cubing both sides, or taking the cube root of both sides, or for any other power or root.

Returning now to our belting formula, let us first multiply both sides by 600. 600 multiplied by $x$ is $600x$, and 600 times $\frac{abc \times 3.1416}{600}$ is $\frac{abc \times 3.1416 \times 600}{600}$ or $abc \times 3.1416$. After multiplying both sides by 600, we have then

$$600x = abc \times 3.1416$$

This operation is called "clearing the equation of fractions." Now let us divide both sides of the equation by all the factors of the right side, except the one we wish to have alone—that is, divide by $a\ c \times 3.1416$. The result is

$$\frac{600x}{ac \times 3.1416} = \frac{abc \times 3.1416}{ac \times 3.1416}$$

In the right side of this equation we have $a$, $c$ and 3.1416 in both numerator and denominator, and we may cancel them out. The result is

$$\frac{600x}{ac \times 3.1416} = b$$

or, turning the equation around,

$$b = \frac{600x}{ac \times 3.1416}$$

in which we have what we want, that is, $b$ the width of belt alone on one side, and all the other quantities alone upon the other. The equation is now said to be "solved for $b$." In its original shape it was solved for $x$. We know that this last equation is true, because we started with an equation and have only done such things to it as will keep it an equation.

Let us now apply this to the original practical problem reversed—that is, let the horse-power be 15.7, the diameter of the pulley 30 inches, and the speed 150, to determine the width of belt:

Substituting these quantities for the letters which represent them in the equation just found, we have

$$b = \frac{600 \times 15.7}{2\frac{1}{2} \times 150 \times 3.1416}$$

Perform these multiplications and we have

$$b = \frac{9420}{1178}$$

Perform the division and we have

$b = 8$ nearly.

This result does not come out exact, as the 15.7 substituted for $\pi$ was not exact. Had the 15.7 been exact, we would have obtained exactly 8 inches, with which we started in the first problem. Problems in which exact results are obtained are very plentiful in the school-books, but very few of them are met with anywhere else.

Additional examples of transposition may be found in Mr. Mason's Article VIII. Thus, he has found for the magnets

$$N=\frac{1.257 C_1 S_1}{\frac{l_1}{A_1 \mu_1}}$$

in which we are supposed to find $N$, having the other quantities known. He tells us that more usually $C_1 S_1$ is to be found, $N$, $l_1$, $A_1$ and $\mu_1$ being given. Heretofore our unknown quantity has been represented by a single letter, but here we wish to find the ampere turns which are represented by $C_1 S_1$. There is no difference in the work; but we are to so transform the equation as to have $C_1 S_1$ alone upon one side, instead of a single letter, as with the belting formula—that is, we must solve for $C_1 S_1$. To do this, Mr. Mason proceeds by multiplying both sides of the equation by $\frac{l_1}{A \mu_1}$. To multiply any fraction by its denominator is to remove the denominator, as, for instance,

$\frac{1}{2}\times 2=1$, or
$\frac{3}{4}\times 4=3$

Hence, multiplying both sides of Mr. Mason's above equation by $\frac{l_1}{A \mu_1}$ gives

$$N\frac{l_1}{A_1\mu_1}=1.257 C_1 S_1$$

Now he divides both sides by 1.257, giving

$$\frac{N\frac{l_1}{A_1\mu_1}}{1.257}=C_1 S_1$$

or, turning the equation around,

$$C_1 S_1=\frac{N\frac{l_1}{A_1\mu_1}}{1.257}$$

Here we have a formula giving the number of ampere turns required to force $N$ lines through the magnet core, but Mr. Mason has said that we require to force v $N$ lines through this core. To do this, we must have more ampere turns, the number being found by multiplying the equation giving $C_1 S_1$ for $N$ lines by v. He thus finds a corrected value for $C_1 S_1$, namely,

$$C_1 S_1=\frac{\mathrm{v} N\frac{l_1}{A_1\mu_1}}{1.257}$$

Proceeding Mr. Mason finds the number of ampere turns required to force $N$ lines through armature and air gaps; that is, he finds a similar formula for $C_2 S_2$ and $C_3 S_3$.

Here again we might take our formula for $C_1 S_1$ and from it find $C_1 S_1$, and so take the corresponding formulas for $C_2 S_2$ and $C_3 S_3$, and find $C_2 S_2$ and $C_3 S_3$. Then since total $C S = C_1 S_1 \times C_2 S_2 \times C_3 S_3$, we might find $C S$ by adding these values of $C_1 S_1$, $C_2 S_2$ and $C_3 S_3$ together. Mr. Mason, however, prefers to express this in the formula, and so get a single formula for $C S$, which he does by writing the formulas for $C_1 S_1$, $C_2 S_2$ and $C_3 S_3$ with the sign of addition between. The case is precisely similar to the one of last week, where he found a formula for the total reluctance of the circuit by adding together the formulas for the reluctances of the different parts. This addition in the first instance will appear

$$C S=\frac{\mathrm{v} N\frac{l_1}{A_1\mu_1}}{1.257}+\frac{N\frac{l_2}{A_2\mu_2}}{1.257}+\frac{N\frac{2l_3}{A_3}}{1.257}$$

The dividing lines of these fractions are opposite the sign of equality, and we observe at once that they have a common denominator. Hence we may write

$$C S=\frac{\mathrm{v} N\frac{l_1}{A_1\mu_1}+N\frac{l_2}{A_2\mu_2}+N\frac{2l_3}{A_3}}{1.257}$$

Having gotten thus far, Mr. Mason finds that each fraction in the numerator has $N$ as a factor. Now, the result is the same whether we multiply the three quantities by $N$ and add the results together, or first add them together and then multiply the sum by $N$. To illustrate,

$4\times 3+4\times 6+4\times 8=68$ and
$4(3+6+8)=4\times 17=68$

He therefore puts the three fractions in a parenthesis, and puts the $N$ outside the parenthesis as a common multiplier, giving his final equation (13). Namely,

$$C S=\frac{N\left(\frac{\mathrm{v} l_1}{A_1\mu_1}+\frac{l_2}{A_2\mu_2}+\frac{2l_3}{A_3}\right)}{1.257}$$

This equation, like the one discussed last week, has a somewhat formidable appearance, but the reader who has read what precedes should be able to readily understand it. It means that to find $C S$ we must add together the three fractions in the numerator, multiply the sum by $N$ and divide the product by 1.257.

The reader is not to infer that the above explanations are sufficient to make him an expert algebraist. It is believed, however, that they are sufficient to enable him to understand and to apply any ordinary algebraic formula. If the derivation of such formulas is still, in some cases, "rocky," it does not prevent the application and the use of the resulting formulas—precisely as many men of prominence in the engineering world use formulas which are obtained by the calculus, without understanding the calculus or being able to follow the work by which the formulas are obtained. It is believed that what has been given is enough to show what algebra is, why it is preferred by writers to arithmetic, and how to make use of its results.

C. K. JACKSON.

## Recent Inventions in Metal-Working Machines and Tools.

A grinding machine for the knives of woodworking machinery, etc., is illustrated in Figs. 1, 2 and 3, its general design being similar to that of a universal grinding machine; and it will be necessary to call attention only to the points of difference to give an understanding of

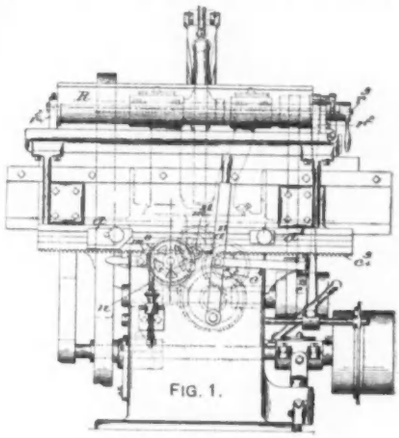

FIG. 1.

GRINDING MACHINE.

the tool, which is the invention of Mr. C. W. H. Blood, of Boston, Mass.

The views represent, respectively, front and side elevations, and a sectional detail of the pump which supplies water to the emery wheel. The power shaft passes through the base of the machine; thence

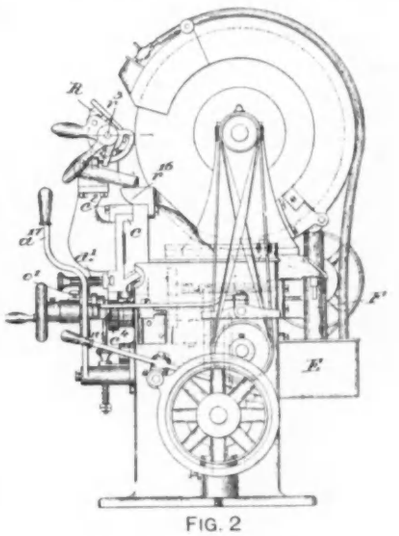

FIG. 2

GRINDING MACHINE.

a belt passes to the wheel shaft on the left (Fig. 1); and from the long pulley at the other side of the wheel, open and crossed belts drive the table-carrying mechanism from the pulley $c^{13}$. This mechanism, located within the box frame, will be readily traced from the dotted lines in

Figs. 1 and 2, and it reciprocates the table by means of the pinion $c^4$ and rack $c^3$. Studs $d^1$, adjustable in a T-slot on the table, automatically reverse the shipping lever $a^{17}$, at the end of the cut. As will be noted in Fig. 2, the upper way $c$ of the table is flat, and is held in place and protected from grit by the angle piece $c^2$.

The knife carrier $R$ is trough-shaped and capable of any desired angular adjustment, the clamp rod $r^3$ passing from end to end and clamping by binding the supports $r^2$ against the ends of $R$. Water

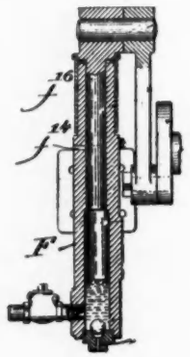


FIG. 3

from the tool holder is caught in the long stationary trough $r^{16}$ and conducted beneath the wheel to the tank $E$.

The forward feed of the emery wheel is effected by the lug $d$ (Fig. 1) striking the roller on $m^{11}$, at the end of the table travel, a spring rod $n$ returning the pawl to its original position. An adjustable housing or guard $o^1$, on the ratchet of the feed shaft, lifts the pawl $m^8$ and automatically stops the feed at any desired point.

The pump $F$ (Fig. 3) is a piston pump, instead of the usual centrifugal type, and is so designed as to preserve an air cushion between the piston and the grit-charged water. At the upper limit of its stroke, the piston rises just above the orifice $f^{14}$, thus insuring a constant supply of air in the pump barrel, which cushion, besides protecting the piston from cutting, permits the pump to run with the discharge pipe closed. The inlet $f$ is small, to prevent an inrush of water sufficient to carry grit against the piston, which is externally protected from cutting by the sleeve $f^{16}$.

## Chinese Railroad Building.

An imperial decree has been issued from Pekin placing the construction of the railroad from Tientsin to Lu Kou Bridge, eight miles west of Pekin, in the hands of Hu-Chii-fen, a native of Kuan Sen province and holding the rank of provincial judge. The cost of the 70 miles of line is stated in the decree to be about $2,000,000, or more than $28,000 per mile. An American engineer recently estimated the cost of this line at $20,000 per mile with rolling stock and equipment complete. The proposed route presents no difficulties, except the necessity of high embankments and numerous drains and culverts in certain localities to cope with the annual floods. It is understood that no foreign capital whatever is to be employed. The decree orders merchants to form stock companies for railroad building, which outlines the present railroad policy of China. There is a strong determination on the part of the Government to exclude foreign capital and foreign control. There is reason to believe, however, that this determination will give way before the magnitude of the undertaking, which will bring to light the inexperience of the Chinese managers. There will then be a great field open there to foreign railroad enterprise. This field has already attracted great attention, and it will doubtless be eagerly disputed by the representatives of the railroad interests of various nationalities. Our minister to China, Mr. Chas. Denby, has not failed on all proper occasions to urge on the Chinese authorities the pre-eminence of Americans in railroad construction and in the manufacture of all those products which China's railroad system will in time require. It would be much to be regretted should this market be allowed to pass without an effort into the hands of others.

## Machinery in China.

Now that the Japanese are evacuating the district of Nuichwang and the Chinese are resuming possession, it is probable that there will be some demand for munitions of war, such as cannon for fortifications — including both large and quick-firing cannons, to replace those captured by the Japanese — repeating rifles and other firearms, large and small.

Steam launches may also be required, and it is not unlikely that there may be an opening for machinery for crushing beans and castor beans, and pressing the crushed seed into cakes; machinery for reeling silk from cocoons, for treating hemp and making rope, for mining coal and precious metals, and various other kinds of machinery.

American merchants and manufacturers in a position to compete for this business should state, among other details, the price (stated in *Shanghai or Nuichwang taels) of goods laid down, but not landed, in Nuichwang harbor, the weight and dimensions of packages, the terms and conditions of payment, whether the goods are of guaranteed quality, whether the price includes a return commission to the importing merchant, etc.

It is to be hoped that manufacturers in this country will recognize the importance of this field now open to them.

*The value of a Shanghai tael is 71.8 cents, and that of a Nuichwang tael is 80 cents.

## An Increase in Our Exports of Manufactures.

The detailed report of exports and imports for the calendar year 1895 is at hand, and shows a rather gratifying improvement in our exports of manufactured articles. The total value of our exports for the year was $807,740,016, being less than half-a-million dollars greater than the year preceding; but there was a marked change in the character of the exports. Agricultural products decreased $25,970,008, while manufactured exports increased $23,351,802.

The exports of agricultural products are determined largely by conditions not within our control, as the crops in other parts of the world really determine the foreign demand more than does our production. But in the line of manufactures, the ability to meet the prices in the foreign markets is, of course, the winning condition, and the results of the year 1895 are therefore to be regarded with some satisfaction.

Increases were shown in our exports of agricultural implements, carriages, street cars, passenger and freight cars, clocks and watches, chinaware, glass and glassware, manufactures of wax, hemp and jute, india rubber and gutta percha, iron and steel, fire-arms, locks, hinges, builders' hardware, nails, saws and tools, scales and balances, sewing machines, stoves, steam engines, wire, lamps and chandeliers, leather and manufactures of leather, musical instruments, naval stores, paints and colors, paper, silk, soap, starch, and manufactures of wood and of wool.

The following shows the total exports and the increase over 1894 for the articles enumerated:

| | 1895. | Increase. |
|---|---|---|
| Agricultural implements | $5,319,885 | $554,092 |
| Carriages and street cars | 1,626,406 | 25,396 |
| Cars, passenger and freight | 1,021,865 | 325,499 |
| Clocks and watches | 1,303,166 | 104,124 |
| Chinaware | 24,872 | 8,562 |
| Glass and glassware | 1,002,328 | 84,809 |
| Gunpowder and other explosives | 1,348,364 | 180,635 |
| India rubber and gutta percha, manufactures of | 1,676,619 | 140,475 |
| Iron and steel and manufactures of | 35,071,535 | 5,127,806 |
| Firearms | 845,110 | 205,011 |
| Locks, hinges, and other builders' hardware | 2,766,532 | 313,800 |
| Machinery not otherwise enumerated | 12,115,118 | 1,390,598 |
| Nails and spikes | 579,435 | 52,127 |
| Scales and balances | 387,710 | 95,655 |
| Sewing machines | 2,988,006 | 923,219 |
| Steam engines | 2,741,465 | 311,830 |
| Stoves and ranges | 289,426 | 48,490 |
| Wire | 1,375,195 | 70,401 |
| Lamps and chandeliers | 682,469 | 24,576 |
| Leather and manufactures of | 18,492,760 | 3,604,692 |
| Musical instruments | 1,153,441 | 85,491 |
| Paper and manufactures of | 2,412,763 | 320,419 |
| Wood and manufactures of | 29,943,154 | 1,844,184 |
| Wool and manufactures of | 782,885 | 46,525 |

Business connected with the engineering trades appears to be slowly though surely improving in Great Britain. The returns of the Amalgamated Society of Engineers, giving the percentage of unemployed members, compare favorably with those of a year ago, in spite of the great strike in the Scottish shipyards, which accounts for about one-half of the

# ✻WANTED✻

*"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.*

**TO SUBSCRIBERS**

whose names appear on our **subscription** list, this paper will give two free insertions under this heading to those in want of positions. The advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

Experienced mechanical draftsman wants steady position. Box 48, AMERICAN MACHINIST.

Wanted—3 first-class lathe hands; good wages, steady work. Eclipse Bicycle Co., Elmira, N. Y.

Wanted—Position as brass foundry foreman by a man of exp. Address J. B., care AM. MACHINIST.

Gas engine designer, with drawing ready made if wanted, desires pos.; South pref. Box 44, AM. MACH.

Position wanted by draftsman. 20 yrs. exp. Gen-machinery. Ref'nces. Address Box 41, AM. MACH.

Expert engr., who has successfully handled large plants, open for engagement. W. L. G., AM. MACH.

Mech. draftsman wants pos., exp. in h. grade eng., water tube boilers, etc. Box 31, AM. MACHINIST.

Wanted—First-class machinists (close workmen). At the works of the Vermont Farm Machine Co., Bellows Falls, Vt.

A practical machinist, American, with some experience on the road, wants a position as traveling man. Box 38, AMERICAN MACHINIST.

Draftsman with practical experience wishes position as foreman; has held similar position. Address A. B., 37 AMERICAN MACHINIST.

Position wanted by mechanical draftsman, age 26. Gen. machinery and pumps. A1 references. City preferred. Box 35, AMERICAN MACHINIST.

Wanted—A good machine tool man as the contractor for the output of entire plant. A good opening for the right man. Box 15, AM. MACH.

Draftsman's asst. desires position in N. Y., has had 7 years' shop and 1 year drawing-room exp. on machine tool work. Box 46, AMERICAN MACH.

Wanted—Position by experienced American mechanic capable of running shop; also skilled in erecting steam and electric mach'y. Box 45 AM. MACH.

Mechanical engineer and draftsman open for engagement; labor-saving machinery, jigs and fixtures a specialty. Box 47, AMERICAN MACHINIST.

Wanted—A good draftsman experienced in engine work. Apply by letter, giving salary required, and references. The Ball & Wood Co., 15 Cortlandt St.

Situation Wanted—Mining master mech. well up in mining and pumping mach. no objection to go to foreign country. Unexcept'l ref. Box 118, Vallejo, Cal.

Mechanical draftsman, designer, graduate, exp. on Corliss engs., boilers, pumps, gen. mchy., wants sit.; Chicago preferred. Address Box 49, AM. MACH.

Wanted—A first-class machinist, exp. in accurate grinding and lap'g of hard'n'd work. The Lanston Monotype Machine Co., Cent'l P. Sta., Wash'n, D.C.

Wanted—Mech. draughtsman desires position. Techn. grad. and 2 yrs. exp. in drwg. room on st'm pumps and gen. m'chin'y. Address K. O., AM. MACH.

Wanted—An energetic and experienced man to take charge of 100 screw machines on first-class work. State age, experience and salary expected. Box 29, AMERICAN MACHINIST.

Sup't open for engagem't; thorough mech.; 12 yrs. exp. Tech. grad. in estimating cost of mach., and executive ability second to none. Good reference. Address Ahora, AMERICAN MACHINIST.

A party with a number of years' exp. in manuf'g business desires a sit. Has had good success in management of help. Best of ref. given. Address Twenty-Three, P. O. Box 2003, Boston, Mass.

Wanted Man of exp. to take charge of tool room in brass-wkg estab. Must be thoroughly familiar with mod. tools and methods; a hustler. No experimenter need apply. Box 30, AMER. MACHINIST.

Wanted Dftsman—For the purpose of compiling & tabulating data in an eng. & boiler works. Accuracy on weights and dimensions; no designing. State experience and wages. V. D., care AM. MACH.

Employment wanted by a man of 30 years' experience as machinist, designer and manufacturer in the best shops of New England. Can give the best of references. Address, Box 43, AMERICAN MACHINIST.

Position of trust by man with 15 years' experience in machine shops, drafting rooms and foundries of leading firms; understands mixing iron; south of Pennsylvania preferred. Address C., care AMERICAN MACHINIST.

Position wanted as superintendent or draftsman; experienced on Corliss and high-speed engines, refrigerating and water-works machinery and special tools; good manager and designer. Alonzo G. Collins, 318 Avenue D, San Antonio, Tex.

Practical mechanic, whose experience in factory and office covers many yrs., wants suitable position. Has worked his way up by no other means but his own energy, and held positions as foreman, chief draftsman, and asst.-supt. Alpha, AM. MACH.

Two young men, technically educated, with shop experience, desire work. Would enter as advanced apprentices in shop offering except'n'l advantages in varied machine construction. One or both may be engaged. Address M. L. S., AM. MACHINIST.

Wanted—Position as brass foundry foreman, thoroughly exp. in mould'g and cast'g all kinds of heavy and light work, also mixing and melting all kinds of brasses and bronzes in air, reverbratory gas furn. & cupola. Geo. Pyne, 4315 Beach Hill Ave., Cin., O.

## MISCELLANEOUS WANTS.

*Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.*

Cheap 2d hd lathes & planers. S.M.York, Clev'd, O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

Best and cheapest Bolt Header made by C. H. Baush & Sons, Holyoke, Mass.

Do you want to manufacture a good gas engine? If so, Address F., AMERICAN MACHINIST.

For Sale—A first-class key-seater, new. Address Mitts & Merrill, 913 Tilden st., Saginaw, Mich.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Co., Cincinnati, O.

A job lot of 200 000 set and cap screws and bolt forgings, in lots to suit. Send for list and prices. F. W. Beals & Co., Lynn, Mass.

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Our Catalogues of Books for Machinists, Engineers, Electricians, etc., also sent free.

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**15 Beekman Street, NEW YORK.**

idle members. In the Manchester district there has been a marked reduction in the out-of-work list, and reports from most districts on the condition of trade are of a very encouraging character.

### Literary Notes.

"Home Study" is the name of a new monthly journal which is designed especially to assist young mechanics and others who wish to follow a course of instruction pertaining to their occupations, and are for any reason unable to attend a regular school. The first number contains articles on "The Principle of Moments," "Expansion of Steam," "Speed and Power," "The Dynamo Water Drips," "Mechanical Drawing," "Angles of Polygons," and many others, all written in a style specially designed for students of these subjects. This new journal seems to be the outgrowth of the "Correspondence School" idea, and is auxiliary to it. It will be appreciated by those for whom it is intended, and will undoubtedly prove helpful to them. It is published by the Colliery Engineer Co., Scranton, Pa.

"Bicycle Repairing" is the title of a book which is intended to assist those whose business it is to make repairs of "the silent steed." As is appropriate and proper, the book contains much matter that a good mechanic will not need; for many of those who straighten bent rims, patch punctured tires and replace broken spokes are "jammers," and have little idea of how a mechanic should or would go about doing a job. Yet there is also much in the book that the occasional mechanic who makes such repairs will find suggestive and helpful, and every subject taken up is fully and clearly illustrated and lucidly explained. A great many of the special appliances that have been devised to facilitate such work are illustrated and described, and scarcely any possible or imaginable break or defect in a wheel fails of obtaining adequate treatment. The book is compiled from articles written for the "Iron Age" by S. D. V. Burr, and is published by David Williams, 96-102 Reade street, New York. Price $1.

## COMMERCIAL REVIEW.

NEW YORK, SATURDAY EVENING, FEB. 15.

We consider this week the subject of electrical machinery. First, however, we give the following statement concerning the iron working machinery trade, which may be taken in connection with the less favorable views based upon average experience of sellers in this market, which we have already published: The Lodge &

Shipley Machine Tool Co., of Cincinnati, O., found that orders for the first three weeks of January were decidedly slow, but better at the last of the month, so that the total of sales was double that of January, 1895. The orders already taken this month are good, and inquiries are much better than at any time since the panic.

### Dynamos and Motors.

Although electrical machinery has to some extent suffered from the causes which have, within the past few months, been injuring trade, and many people are talking despondently at the present time, a fair volume of business is being transacted, and the prospects offer some encouragement. That February has seen little or no change from January's situation is evidenced by the differing views taken by various authorities, as to whether demand is increasing or slackening. Perhaps the salutary tendencies of the bond sale may soon have their effect. The General Electric Co. looks for a better business this year than last, if not better than in the past five years.

A class of electrical machinery, which, perhaps more than any other, maintains a firm and healthy tone, is that of dynamos for isolated electric lighting plants. Though not especially a seasonable line of goods, it is said to be in best selling early in the summer, so we may anticipate a very prosperous trade at that time.

Street car motors, on the other hand, are beginning to be in season, for road work opens up in the spring, and the equipment of summer cars is a factor in this branch of trade; consequently there is now a comparatively large demand for this class of machinery. But its sale probably suffers more relative retardation from public lack of confidence than do some other classes of electrical goods. Street railways involve more extensive outlays than lighting plants, and it is natural that in times of financial uncertainty people should be slow to invest in them. Thus, while there is considerable trolley work projected, much of it may not be carried into execution before next Fall. Electrical manufacturers suffer indirectly also from a too high capitalization of already existing roads. One of the most hopeful subjects in connection with car motors is the tendency to apply electricity to roads hitherto operated by steam.

Stationary motors, at least the smaller sizes, are in fair selling. They are becoming popular for factory purposes, and buildings are sometimes supplied with electrical power, to be rented with the several floors. Undeniably, prices of electrical goods have reached a low stage. In one quarter there is a rumor of advancement, but it does not seem that the present state of the market can justify a general upward movement. The decrease in prices which has been going on during the past ten or fifteen years, as a result of


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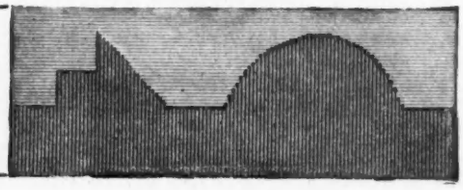
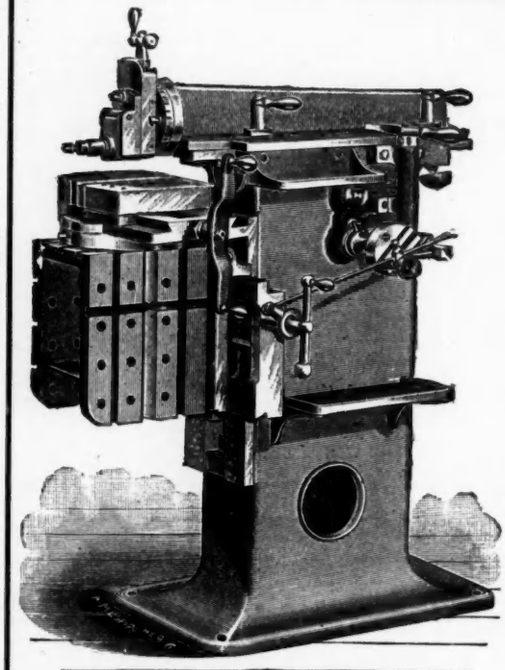


This Cut shows how stroke can be Adjusted with Machine in motion by the Micrometer Adjustment, fine and delicate.



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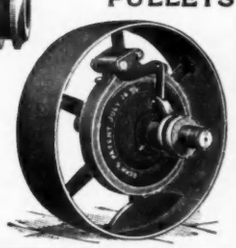
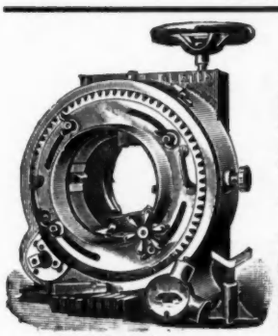

—AND—
CUT-OFF COUPLINGS.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the expiration of patents, of improvements in manufacture, and of competition, has, according to the Brush Electric Co., been greater in the hard times of the last two years than for any similar period, and the figures have apparently reached bottom.

The fluctuations in business experienced during the first few weeks of this year by the Card Electric Co., Mansfield, O., have been as follows: January opened with the inevitable quiet of invoice time, and continued in a waiting condition, but with improving outlook, until the middle of the month, when orders came so abundantly as to bring the monthly average up to the normal. At the close of January the public financial situation occasioned a temporary hesitation in trade, but the result of the national loan has given some assurance, and indications are favorable for an active spring business.

### Iron and Other Metals.

The volume of business transacted in pig iron has assumed fair, although not extraordinarily large proportions, and no great change has taken place since last report. Rolling mills are now among the important buyers, and foundry pig is healthy in tone. In the West, the agreement between ore producers is said to be certain. As will be seen by our quotations, prices have been weaker.

Copper, especially the electrolytic, has been in heavy demand, and the prices have stiffened. Some buyers have stocked up for six months ahead. The January production for the United States was the largest of any month up to date, being 16,072 tons, as compared with 11,694 tons for the corresponding month last year.

Pig tin has advanced in price, as a result of London speculation. There was not a heavy demand in this market.

Pig lead and spelter have been in moderate buying, and the prices are at nearly the same level as a week ago.

## QUOTATIONS.

NEW YORK, Monday, February 17th.

Iron—American pig, tidewater delivery:

| | |
|---|---|
| No. 1 foundry, Northern | $12 75 @ $13 50 |
| No. 2 foundry, Northern | 12 00 @ 12 50 |
| No. 2 plain, Northern | 11 25 @ 11 75 |
| Gray Forge | 11 25 @ 12 00 |
| No. 1 foundry, Southern | 12 50 @ 12 75 |
| No. 2 foundry, Southern | 12 00 @ 12 25 |
| No. 3 foundry, Southern | 11 50 @ 12 00 |
| No. 1 soft, Southern | 12 00 @ 12 50 |
| No. 2 soft, Southern | 11 75 @ 12 25 |
| Foundry forge, Southern | 11 00 @ 11 75 |

Bar Iron—Base, in Carloads—Mill price on dock: common, 1.20 @ 1.30c.; refined, 1.30 @ 1.50c. Store prices: common, 1.50 @ 1.60c.; refined, 1.60 @ 1.80c.

Tool Steel—Ordinary sizes, standard quality, 5¾ @ 7c.; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—About 1.55c. in carloads mill price; from store, 1.85c. Special brands upward.

Cold Rolled Steel Shafting—Base, 2½c. in carloads; 2¾c. in smaller quantities; 3c. from store.

Copper, Carload Lots—Lake Superior ingot, 10¾c.; electrolytic, 10½c.; casting copper, 10c.

Pig Tin—For wholesale lots, 13.50 @ 13.60c.

Pig Lead—In carloads, 3.15 @ 3.17½c.

Spelter—Western brands, 4.05 @ 4.10c. in carloads, New York delivery.

Antimony—From store, in cask or wholesale lots, Cookson's, 7¾ @ 7⅞c.; Hallett's, 6⅞ @ 7c.; Japanese, 6¾ @ 6⅞c.

Lard Oil—Prime city, present make, 51 @ 53c. in large quantities.

## MANUFACTURES.

At Kansas City, Mo., is a new concern known as the Kansas City Ice Machine Co. The incorporators are F. E. Burroughs and others, and it has a capital of $50,000.

The Davis & Egan Machine Tool Co., of Cincinnati, O., have been awarded the contract for over $5,000 worth of special machinery by the Muskegon Chemical Engine Co., for the manufacture of the patent ball-bearing axles which are used on their fire engines.

The Treasury Department, through the Supervising Architect, is inviting proposals until March 6th, for all the labor and materials required for the low pressure, return circulation, steam heating and ventilating apparatus for the United States Post Office Building at Roanoke, Va. Prospective bidders may obtain additional particulars by addressing Hon. Wm. Martin Aiken, Supervising Architect, Washington, D. C.

The Treasury Department, through the Supervising Architect's Office, is inviting proposals until March 3d, for all the labor and materials, and fixing in place complete, the low pressure, return circulation, steam heating and ventilating apparatus, etc., for the United States Court House and Post Office Building at Wilmington, Del. Prospective bidders may obtain additional particulars by addressing Hon. Wm. Martin Aiken, Supervising Architect, Washington, D. C.

## NEW CATALOGS.

*There are three sizes of Standard Catalogs, 9"X12", 6"X9" and 4½"X6". We recommend the 6"X9" size for machinery catalogs. When they must be larger or smaller, one or the other standard sizes should be adopted if possible.*

Fairbanks, Morse & Co., Cleveland, O., send us an illustrated catalog of their gas and gasoline engines, which are arranged in sizes from the smallest usually made to fifty horse-power, and have a hand starting attachment which increases the facility of handling very much. The engines have also other new and unique features which will make them of interest to those who have use for such machines. The catalog is sent to those interested on application, and is 5 x 8 inches.

Fairbanks, Morse & Co., Cleveland, O., send us a catalog describing and illustrating duplex steam pumps manufactured by them; these pumps are simple and compound, of the well-known Worthington type, but with some special features of construction peculiar to themselves. A great variety of pumps are shown, adapted to various service; and the catalog also contains considerable data and information of use to those who have to do with pumping machinery of any kind. It is sent to those interested on application, and is 5⅝ x 7⅞ inches.

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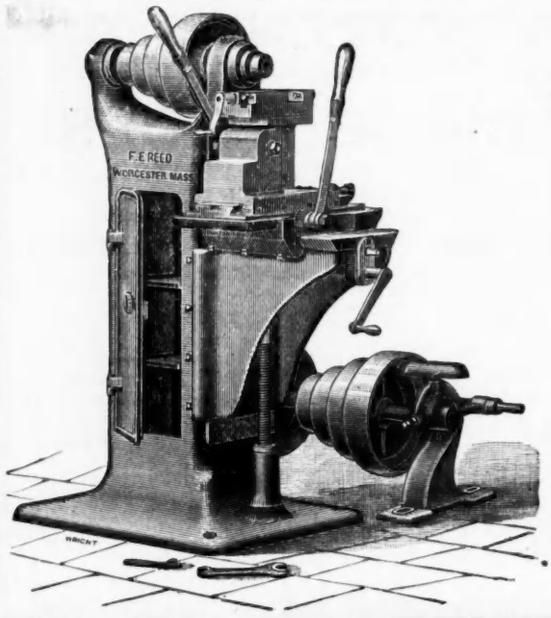

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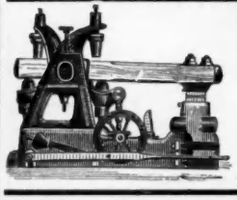

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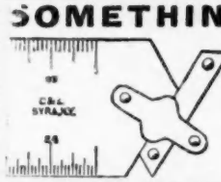

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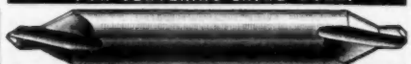

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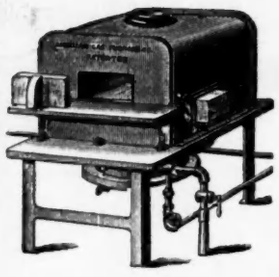

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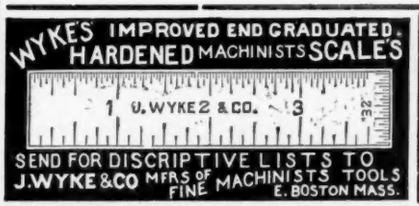
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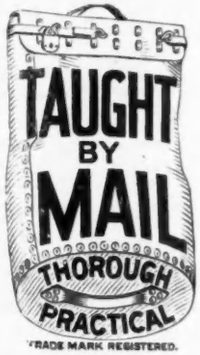


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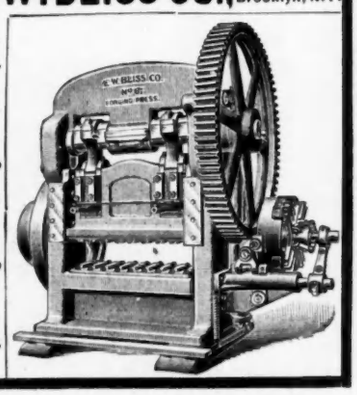

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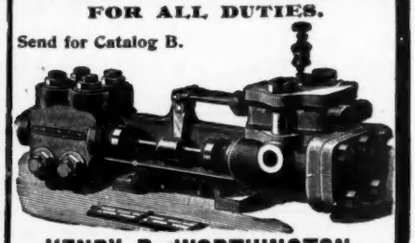

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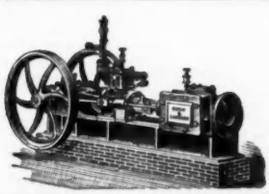

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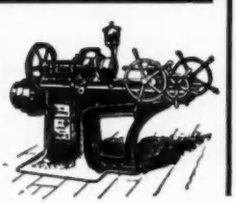

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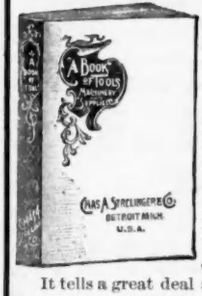


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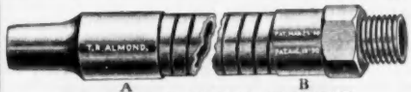


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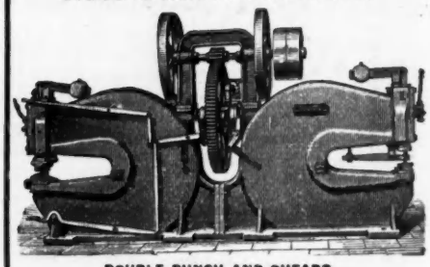

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